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BULLETIN OF THE U.S. DEPARTMENT OF AGRICULTURE

No. 136



Contribution by the Office of Public Roads, Logan Waller Page, Director.
February 12, 1915.

HIGHWAY BONDS:

A COMPILATION OF DATA AND AN ANALYSIS OF ECONOMIC
FEATURES AFFECTING CONSTRUCTION AND MAINTENANCE
OF HIGHWAYS FINANCED BY BOND ISSUES, AND THE
THEORY OF HIGHWAY BOND CALCULATIONS.

BY

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INTRODUCTION.

The practice of issuing bonds for highway and bridge construction by counties and their subdivisions has become common. In 1,230 counties, or 41.1 per cent of all the counties in this country, there were outstanding highway bonds on January 1, 1914. The total amount of such bonds voted,¹ as ascertained by the Office of Public Roads up to that date, was \$286,557,073, of which township bonds alone amounted to \$57,153,718. The amount of outstanding local highway bonds on January 1, 1913, was approximately \$202,007,776. This amount was increased during the year 1913 by current issues noted below, but was also slightly decreased by maturing payments.

The county highway bond is essentially a municipal bond; that is, a bond issued by a public corporation. Statistics indicate that all municipal bonds constitute about 20 per cent of the total of all bonds issued, while Government bonds are about 10 per cent. Municipal bonds are regarded as excellent investments and are frequently used by banks as a second reserve. The amount of highway bonds issued is indicated by comparison with the \$79,741,688 of irrigation and drainage bonds authorized in the interval from 1907 to 1912, inclusive.

¹ "Voted" is almost equivalent to "issued," except in State highway bonds. The difference between bonds voted and bonds sold in 1912 was a little over 3 per cent.

The progress of the local highway-bond movement is further indicated by the diagram of first issues for the interval 1900-1913. Dates of first issues were reported, however, for only 579 counties. First issues for 1912 and 1913 are practically complete. (Pl. I, fig. 1.)

During the past three years county, district, and township highway and bridge bonds were voted as follows: 1911, \$29,200,022; 1912, \$32,022,703; 1913, \$50,445,756; making a total of \$111,668,481.

There have also been voted State highway bonds which now total \$158,590,000.¹ The grand total of all highway bonds voted and reported to the Office of Public Roads to January 1, 1914, is, therefore, \$445,147,073.

There is given in Appendix A of this publication a list of all the State highway bonds with their dates of issue, terms, and nominal interest rates, together with other pertinent information concerning the issues.

In Appendix B are given three lists of local highway and bridge bonds. First there is a list of county and district highway and bridge bonds voted to January 1, 1914, with their terms and interest rates where reported. A similar table of township bonds is next presented. In a separate table is a list, by counties, districts, and townships in the several States, of highway and bridge bonds reported voted during each of the years 1912 and 1913.

The approximate distribution of local highway bonds is shown in the map, Plate II, by counties. State highway bonds are not included.

In collecting data for this publication the Office of Public Roads corresponded directly with county and township officials and the tables of bonds were submitted to State highway officials and other State officials for corrections and additions. Many county officials failed to state the term of the highway bond issues; it was found, however, that the mean term for approximately \$47,000,000 issued prior to 1913 was 24.8 years. For the years 1912 and 1913, the term of issue, the number of issues, and the total amount issued by municipalities with complete reports are presented in the following table:

TABLE 1.—*Bond issues during 1912 and 1913 in counties, districts, and townships, with complete returns.*

Total number of issues.	Terms of issues.	Total amounts of issues.
17	5-year.....	\$442, 175
100	10-year.....	5, 163, 383
13	15-year.....	1, 266, 500
68	20-year.....	8, 906, 538
31	25-year.....	5, 518, 150
45	30-year.....	7, 399, 000
129	Serials.....	15, 300, 819
47	Above 30-year...	7, 170, 971
47	Other term.....	1, 816, 541

¹ Including \$3,415,000 issued by Connecticut, Massachusetts, and New Hampshire in 1913. Massachusetts authorized, in 1912, \$5,000,000 to be issued during the years 1913 to 1917, inclusive, which is part of the total given. New York's second \$50,000,000 will probably not be entirely issued for several years.

These figures represent 61.2 per cent of all the counties, townships, and districts reporting bond issues during 1912 and 1913.

The reports on the mileage of road constructed from the proceeds of local bond issues are very incomplete and in many instances contradictory. After eliminating all reports which were obviously incorrect or defective, a list of counties and districts giving complete returns of classified mileage of roads constructed has been made. A similar list for township work has also been made. These two lists are presented in Appendix B. It is quite probable that omissions in reports from counties and their subdivisions concerning mileage built are due in part to the frequent changing of local officials.

It will be seen from the diagram of first issues (Pl. I, fig. 1) and from the fact that probably over 80 per cent of local bonds for highways and bridges are still outstanding (see p. 3), that the highway bond movement has yet to meet the test of repayment. The maximum outlay for retirement of outstanding highway loans will apparently be reached in about 20 years.

If highway bond issues are to continue successfully, certain fundamental principles require attention. They are, therefore, discussed briefly in this publication. Necessary information is presented in considerable detail with illustrations and tables to guide highway officials in borrowing and expending highway funds.

COUNTY HIGHWAYS.

The highways of a county may usually be classified into main market roads, intercounty roads, and neighborhood roads. A relatively large percentage of the total mileage—more than 80 per cent in many counties—may be classed as neighborhood roads, which are either feeders to market roads or crossroads of relatively small importance. The intercounty roads are usually in part also main market roads. The market roads are, therefore, the roads for which the question of borrowing money frequently arises. The total mileage of main market roads varies greatly from county to county, but usually does not exceed 150 miles.

The distribution and individual lengths of market roads is of much importance to the highway engineer, who must plan for improvements. Rules can not be laid down which will apply universally for the selection of such roads. The area served by a given market road depends upon the length of the road and the form of the road network, which, in turn, is largely governed by topography and the situation of shipping points. In regions where the public land survey system prevails the roads very generally follow the section lines and radial roads are not common.

It is usual to find from four to eight main market roads radiating from market centers. The average number of such roads of considerable length is about six for each shipping point. The traffic on

radial roads will tend to vary inversely with their number. Plates IV, VI, and IX show the distribution of the main market roads in three counties.

ECONOMIC VALUE OF THE MARKET ROAD.

The service rendered by highways radiating from a town may be measured directly by the tonnage which is hauled over them; and their economic importance is indicated by this tonnage and varies directly with it. There are two ways of computing the tonnage of traffic on a road: (a) By actual count, and (b) by determining traffic areas supplemented with producers' and merchants' estimates of tonnage.

The actual count of traffic determines the average number of teams hauling produce each day, their loads, and the average distance traveled. From the count on a sufficient number of days a close estimate of the average annual traffic may be had.

TABLE 2.—*Traffic record of seven unimproved roads.*

Road No.	Location. ¹	Length in miles.	Tons per day, each area.	Average haul (nearest mile).	Equivalent annual ton-miles.	Merchants' and producers' estimates (ton-miles).	Traffic area (acres).	Reported costs (cents per ton-mile).
1	Lauderdale County, Ala. (2).....	28.3	58	10	367,894	228,046	154,432	16.0
2	Boone and Story Counties, Iowa (16).....	45.1	10	2	162,342	105,662	113,521	37.2
3	Cumberland and Sagadahoc Counties, Me. (8).....	32.1	18	4	227,451	.....	38,182	23.6
4	Leflore County, Miss. (3).....	24.1	33	7	197,386	90,628	60,736	36.2
5	Montgomery County, Md. (1).....	5.4	21	2	14,044	5,892	12,531	26.0
6	Muskingum County, Ohio (2).....	20.9	28	6	111,026	132,711	41,952	28.0
7	Jackson County, Oreg. (3).....	50.5	11	4	51,810	32,170	73,881	36.6
	Totals and averages.....	206.4	26	5	1,131,953	.....	495,235	29.1

¹ Numbers in parentheses indicate the number of traffic areas.

From a map, supplemented by field observations, the traffic area served by a highway may be determined. This is the area on which originates market produce and for which supplies must be hauled from market. In a wheat country, for example, the average annual wheat acreage tributary to a highway will determine approximately the principal market traffic. Even a rough estimate of the traffic area is valuable for determining the relative importance of highways and indicates the order in which their improvement should be undertaken. It is also an excellent check on traffic count. Traffic data for a number of roads recently investigated by the

Office of Public Roads are given in Table 2. Actual traffic count was made four times for seven consecutive days on all the roads. The traffic areas, traffic estimates, and the hauling-cost data were determined in the field. The weight derived from loaded teams and motor trucks only is entered in this table, and the ton-mile hauling costs include a slight increment for loading and unloading.

Highway improvement with borrowed money must be regarded as an investment. The only way, however, that a measurable income arises from the investment is by the reduction of hauling costs. From the standpoint of public economy the annual cost of hauling represents the operating expenses of the road system. The direct return upon the highway investment, then, is the reduction in operating expenses. This difference between the old hauling costs and the hauling costs over the improved roads is a real saving to the community. In the language of railroad bookkeeping, this difference is an operating income to the community. It is invariably true that the improvement of market roads is followed by an increase in annual tonnage, so that estimates based on the existing tonnage are usually conservative. Doubtless much more money can be spent for well-planned and well-built roads without overcapitalizing them.

The unit in which hauling costs are measured is the ton-mile. The cost of hauling a ton 1 mile on a poor road probably varies on an average from 20 to 35 cents. (See Table 2.) It depends on the condition of the road and changes greatly during the year. Recent figures for hauling over unimproved roads in the mountain regions of West Virginia and Kentucky also show seven instances where the cost per ton-mile varied from 23 to 37 cents. Ton-mile costs as low as 10 cents are common in Europe on first-class highways. Even with the extreme variations of wages it is doubtful if the cost per ton-mile anywhere in this country on an adequately improved road exceeds 15 cents. Cross ties were hauled over improved gravel roads in Spotsylvania County, Va., in April, 1913, for about 12.7 cents and less per ton-mile, and apples were hauled by motor trucks on good roads in Jackson County, Oreg., in October, 1913, for a little more than 11 cents a ton-mile.

To understand how many tons a highway can carry in a year, assume a market town from which radiate six roads uniformly distributed and 12 miles long. There is then a circular traffic area of 12 miles radius and each road serves theoretically one-sixth of this area, which is 75.4 square miles. The average haul for each separate road is about 8 miles. (See p. 8.) If each acre tributary to this road supplies only 200 pounds of produce, which must move to market an average distance of 8 miles, the road carries an annual traffic of at least 38,605 ton-miles. Another way to view this traffic

is to divide the total number of tons by the number of hauling days, which is usually taken at 300. With an acreage yield of 200 pounds there result 16 tons per day which may be assumed to move an average distance of 8 miles. This would make a total of 128 ton-miles daily. The daily average weight over the entire road is therefore about 10.7 tons. The tonnage hauled is the most direct and reliable basis from which to determine the economic value of a road. (See Table 2.)

It is common to find that when a poor market road is improved the cost of hauling is reduced by from 2 to 10 cents per ton-mile. The saving to the community during a year can then be readily computed for each mile. (See Pl. III, fig. 2.)

Table 3 shows the annual saving per mile and the capitalized amount of this annual saving at 5 per cent interest for daily traffic varying from 5 to 80 tons.

TABLE 3.—*Annual saving per mile in hauling costs at 5 cents per ton-mile reduction.*

Tons per day.	Total saved in year of 300 days.	Capitalized at 5 per cent.	Tons per day.	Total saved in year of 300 days.	Capitalized at 5 per cent.
5	\$75	\$1,500	45	\$675	\$13,500
10	150	3,000	50	750	15,000
15	225	4,500	55	825	16,500
20	300	6,000	60	900	18,000
25	375	7,500	65	975	19,500
30	450	9,000	70	1,050	21,000
35	525	10,500	75	1,125	22,500
40	600	12,000	80	1,200	24,000

If the roads do not radiate uniformly from a town it is evident that in a uniformly producing area the traffic lost to one road must go over some adjoining road. However produce is distributed along the road, in general, the portion of the road nearer the market will receive much more use than the distant portion. The first few miles of radial road from a town are also much used by vehicles other than market vehicles.

Although a very important matter, the average haul on a market road is somewhat difficult to determine. It may be estimated from the maximum haul or the known radius of the traffic area,¹ and may usually be assumed to be two-thirds of the average maximum haul.

To show further the service which market roads render to a community, there is given in Table 4 the yearly and daily tonnage pass-

¹ In Bulletin No. 49 of the Bureau of Statistics of the U. S. Department of Agriculture, entitled "Cost of Hauling Crops from the Farms to Shipping Points," the average haul is assumed to be the radius of the circle whose area is one-half the area of a circle whose radius is the maximum haul. The average haul is then about seventy-one hundredths of the maximum haul. If all produce on a traffic area of one-sixth of a complete circle were hauled directly from the point where it originates to the market at the center, the resulting average haul would be sixty-seven hundredths of the maximum haul, which is the radius of the sector. If all produce were first concentrated on the middle radius of the sector, the average haul resulting would be sixty-four hundredths of the radius.

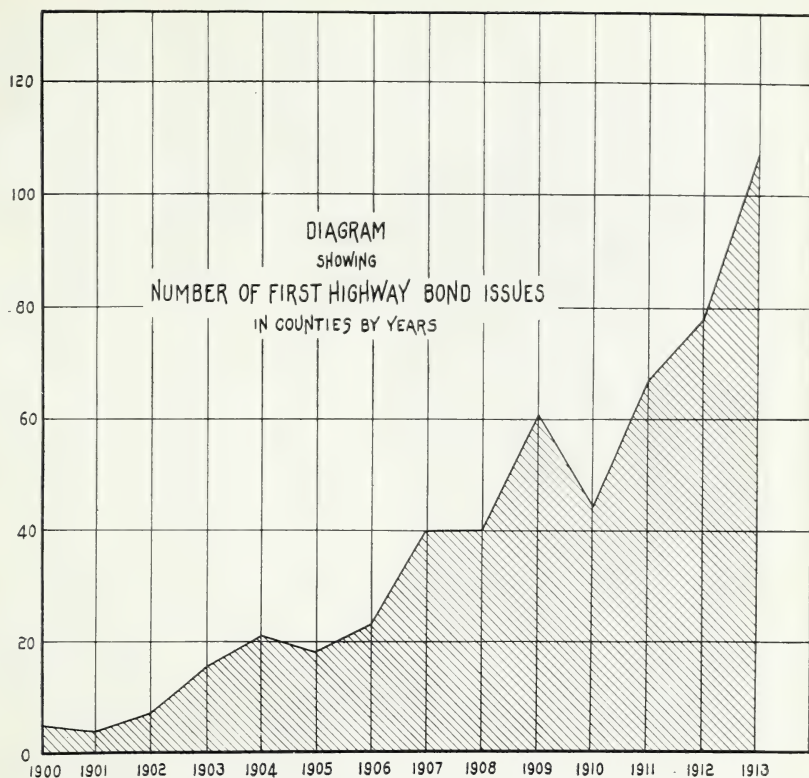


FIG. 1.—DIAGRAM SHOWING NUMBER OF FIRST HIGHWAY BOND ISSUES IN COUNTIES BY YEARS.

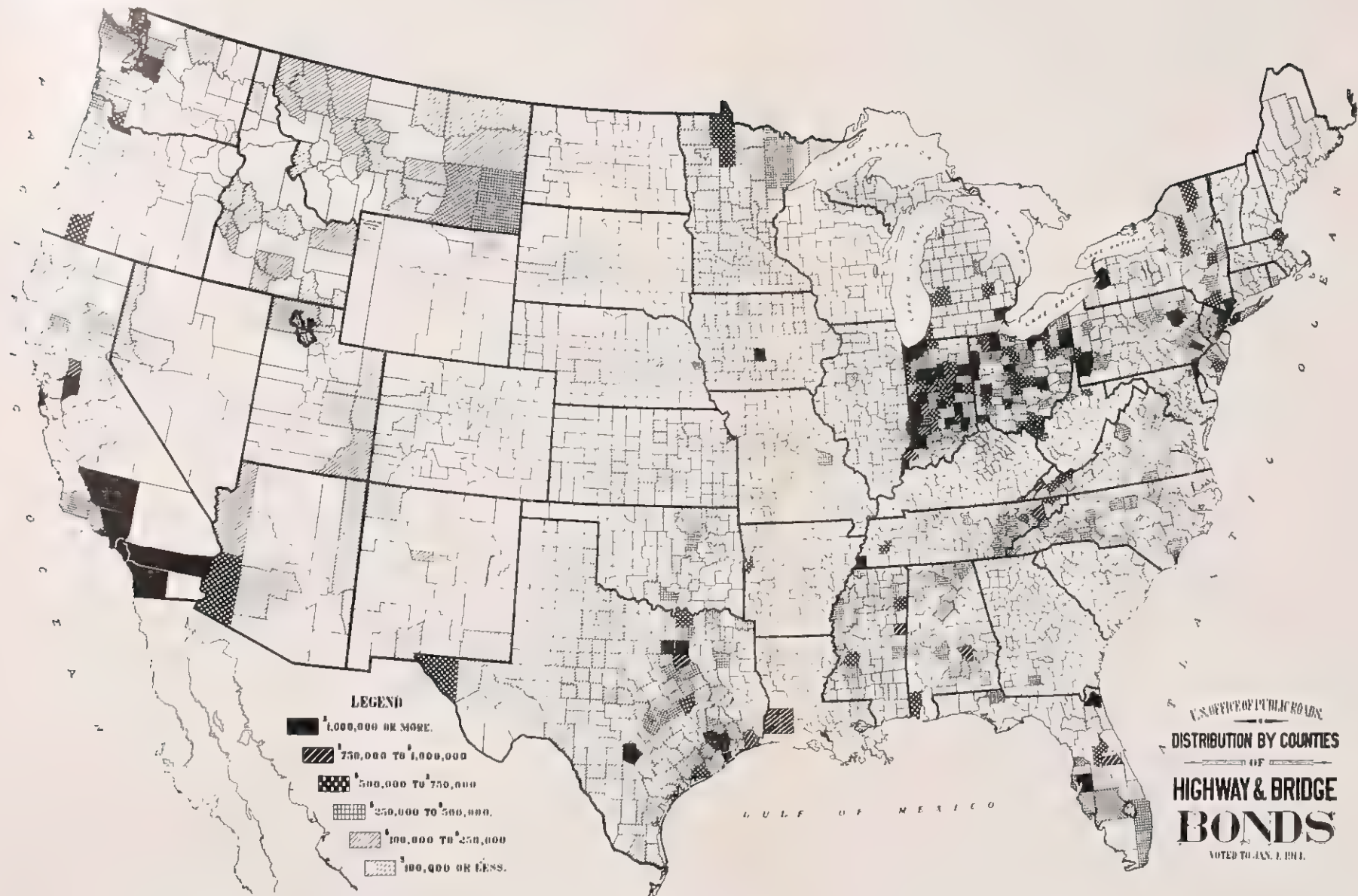


FIG. 2.—POOR MACADAM CONSTRUCTION OF 1911 AFTER 1 YEAR.

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MAP OF THE UNITED STATES SHOWING THE DISTRIBUTION BY COUNTIES OF HIGHWAY AND BRIDGE BONDS VOTED TO JANUARY 1, 1914.

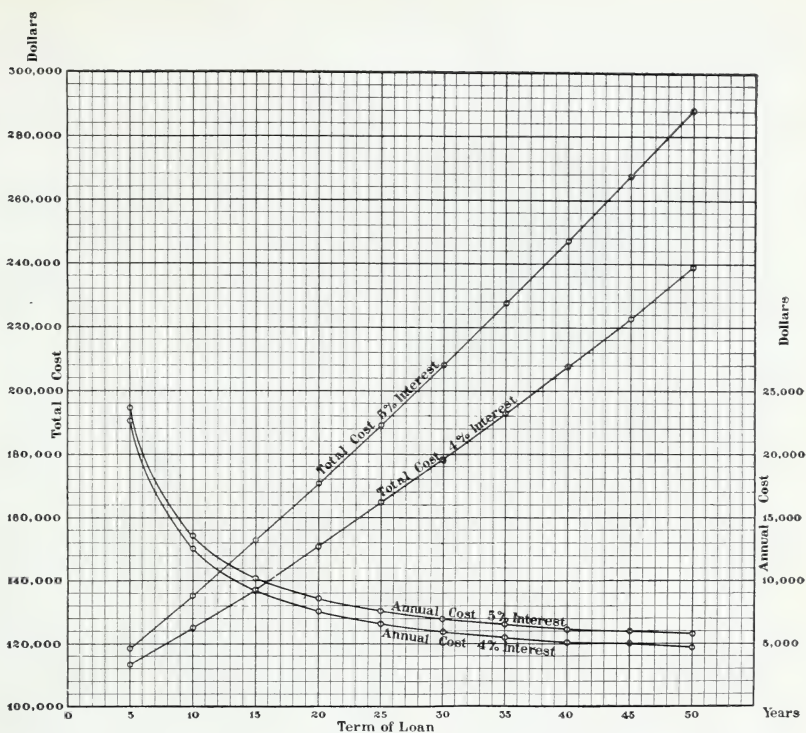


FIG. 1.—DIAGRAM SHOWING THE RELATION BETWEEN ANNUAL AND TOTAL COST AND THE PERIOD OF HIGHWAY BONDS—\$100,000 SINKING FUND, $3\frac{1}{2}$ PER CENT.

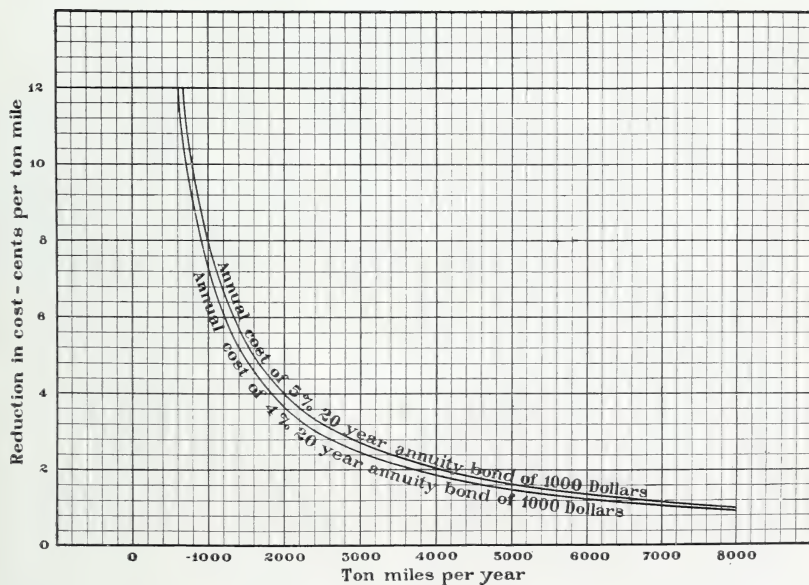
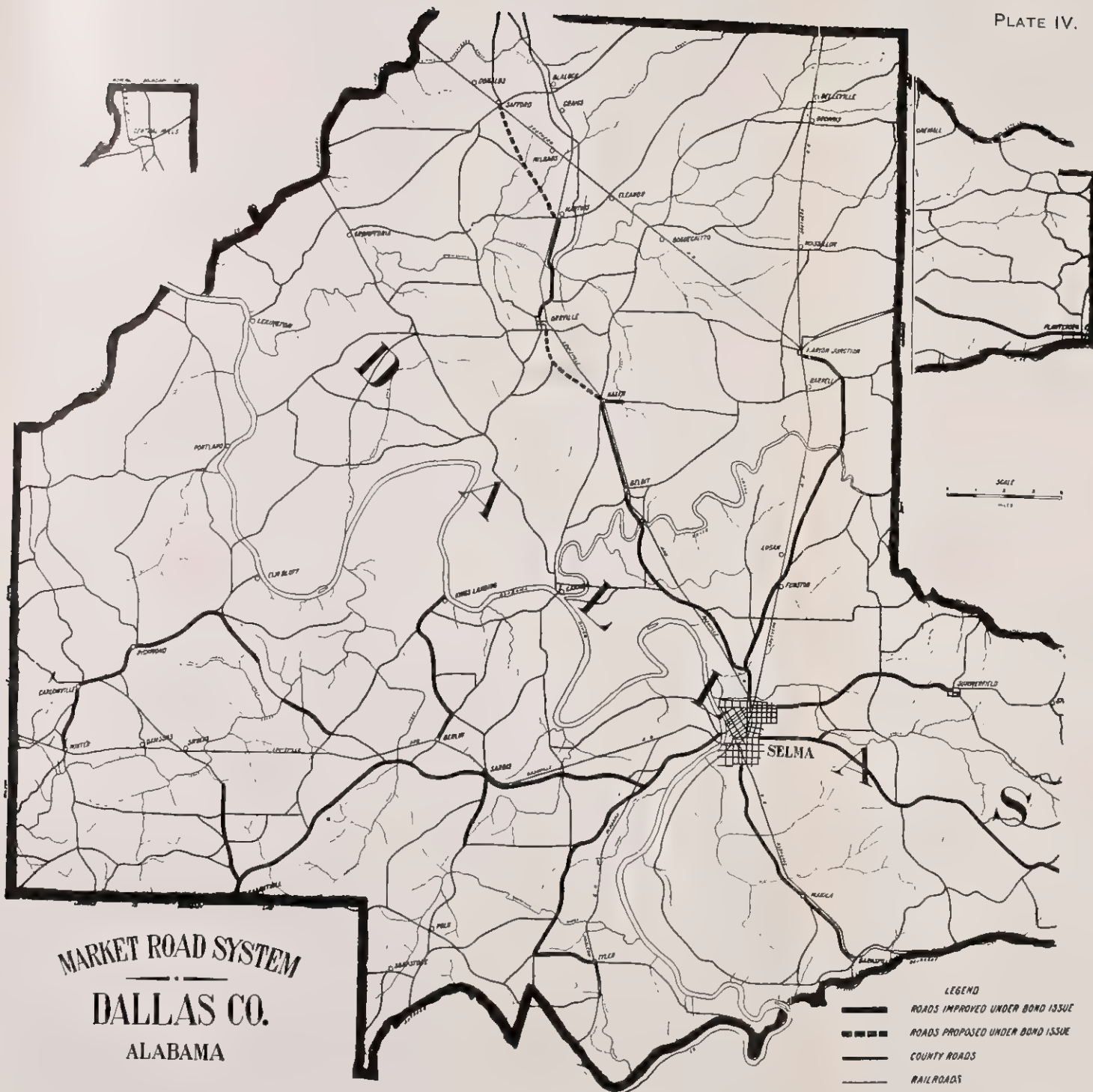


FIG. 2.—DIAGRAM SHOWING THE RELATION BETWEEN TOTAL REDUCTION IN COST OF HAULING AND ANNUAL COST OF A \$1,000 BOND.



MAP SHOWING MARI



MAP SHOWING MARKET ROAD SYSTEM, DALLAS COUNTY, ALA.



ing over six market roads assumed uniformly distributed about a market center and extending from 1 to 15 miles through a territory each acre of which yields the same weight of market products.

TABLE 4.—*Theoretical average tonnage on each of six uniformly distributed market roads.*

Maximum haul.	Average haul.	Uniform yield per acre of—							
		One-tenth ton.		One-fourth ton.		One-half ton.			
		Total tons per year.	Tons hauled per day.	Total tons per year.	Tons hauled per day.	Total tons per year.	Tons hauled per day.		
			Over first mile Over eighth mile.		Over first mile Over eighth mile.		Over first mile.	Over eighth mile.	
1	0.66	33.5	0.07	88.8	0.17	167.5	0.34		
2	1.32	134.0	.40	335.0	1.00	670.0	2.01		
3	2.00	301.6	.96	734.0	2.40	1,508.0	4.80		
4	2.67	536.2	1.74	1,340.5	4.36	2,681.0	8.71		
5	3.33	837.8	2.75	2,094.5	6.87	4,189.0	13.74		
6	4.00	1,206.2	3.98	3,015.5	9.95	6,031.0	19.90		
7	4.67	1,642.2	5.43	4,105.5	13.58	8,211.0	27.15		
8	5.33	2,144.8	7.11	5,362.0	17.76	10,724.0	35.52	4.25	
9	6.00	2,714.5	9.00	6,786.3	22.51	13,572.5	45.02	13.75	
10	6.67	3,351.2	11.13	8,378.0	27.82	16,756.0	55.63	24.35	
11	7.33	4,055.8	13.47	10,138.5	33.68	20,279.0	67.35	36.10	
12	8.00	4,825.7	16.04	12,064.3	40.10	24,128.5	80.20	48.95	
13	8.67	5,663.3	18.83	14,158.2	47.08	28,316.5	94.15	62.90	
14	9.33	6,568.0	21.85	16,420.0	54.63	32,840.0	109.25	77.95	
15	10.00	7,540.0	25.09	18,850.0	62.73	37,700.0	125.45	94.15	

The average acreage yield in pounds or the acreage coefficient varies with the locality. As market roads are usually located through farming country, the weight of crops per acre of farm land is a good indication of the tonnage originating on market roads.¹ The report of the 1910 Census shows an approximate average product of 332 pounds per acre of farm land. The average yield per acre on *improved* farm land in crops was 1,674 pounds.² The average weight per acre of forest products on unimproved farm land was 122 pounds.³

It is found that usually 20 per cent of the roads in any county carry nearly all the traffic—possibly 90 per cent of the total. In the United States 20 per cent of the total mileage of roads is about 440,000 miles. There is an average of about 2,000 acres of *farm* land to each mile of such road, which should represent about 65 per cent⁴

¹ There is a considerable return haul of fertilizer, fuel, kerosene, supplies, wire fence, etc., which can be partially determined by thorough inquiry of dealers.

² A careful computation of the weight per acre of all marketed crops in Tompkins County, N. Y., based on the data of Bulletin No. 295 of the Cornell Agricultural Experiment Station, gave 0.51 ton per acre of land in cultivation, which was 70 per cent of the total farm area and 63 per cent of the total area. The acre yield for the entire area was, therefore, 0.35 ton.

³ These figures are derived by determining the weight and acreage of each crop reported and by making reasonable assumptions as to distribution in the case of fruits, etc., where acreage was not given. (See Table 2.)

⁴ The average per cent of lands in farms in 39 States which reported more than 20 per cent of their areas in farms in 1910 was 55.16.

of the adjacent land. On each of the six radial market roads which have been assumed for the calculations above there would be a traffic area of 4,021 acres and a *farm* area of 2,614 acres per mile.

COST OF HIGHWAY CONSTRUCTION.

The cost of a given type of highway varies, but the range of variation has become comparatively well defined for each type within a given region. The standard of construction for any given type is now also generally understood and adhered to in the best practice. As this standard becomes more generally adopted, the price variation for similar local conditions will become less. In Table 5 there are given examples of cost per mile for three types of modern State highways. These averages are taken from lists of State construction jobs which are tabulated in Appendix C.¹ The standard which present specifications represent is a necessary standard evolved as the result of 20 years of modern road building. When these standards are ignored, it is usually at the expense of good work.

TABLE 5.—*Cost elements of three types of highways.*¹

Type.	Drainage and grading.	Surfacing.	Total.	Drainage and grading.	Surfacing.
				<i>Per cent.</i>	<i>Per cent.</i>
Gravel (20 feet wide).....	\$1,817	\$2,599	\$4,416	41.15	58.85
Ordinary or water-bound macadam (15 feet wide).....	3,400	5,815	9,215	36.90	63.10
Bituminous macadam (15 feet wide) ²	2,765	7,533	10,298	26.85	73.15

¹ These cost elements were obtained from 87 gravel jobs and 104 macadam jobs in Maine and New Jersey, and from 53 bituminous-macadam jobs in Maine, Massachusetts, and New Jersey. The averages were computed by weighing each job with its relative length and reducing all costs by simple proportion to equivalent average widths of 20 feet and 15 feet respectively. The complete tables of cost elements on the 244 jobs are given in Appendix C.

² Includes eight jobs of bituminous resurfacing. (See footnotes, Appendix C.)

The cost of highway construction may be subdivided into (a) cost of enduring features and (b) cost of perishable features. When roads are built with accepted standards of grade, alignment, drainage structures, and foundations, the cost of such elements may be charged for enduring features. Whether roads so built result in the maximum percentage of permanent investment depends in part upon the cost and nature of the wearing surface. For example, a highway completed with all the best enduring features and then surfaced with gravel would show a higher percentage of cost for enduring features than the same road surfaced with more expensive material, as ordinary macadam or bituminous macadam. A poorly constructed gravel road, however, where enduring features had been slighted, would present a very high percentage of charge for temporary features. Macadam roads, so called, have been built with bond money by simply spreading broken stone in the mud. An example is shown in Plate I, figure 2.

¹ These examples were selected from States in which records were kept so as to permit cost analysis.

In issuing bonds for building highways the element of investment is of great importance. The allowable variations in grade and alignment are considerable, as are also the variations in the types of drainage structures. But there exists always a minimum standard below which it is uneconomical for any community to build on borrowed money.

It is manifestly poor policy to build an expensive surface or a relatively long-lived surface on defective grades with poor alignment, or where the drainage features are short-lived and temporary. Construction should be so adjusted to the service needed that its purpose is accomplished without waste. A county with impassable muddy clay roads must obtain, with a bond issue of \$100,000, a maximum mileage of improvement. If roads are constructed costing \$10,000 per mile, but 10 miles can be built. It is quite probable that the best economic result will be obtained by building 40 miles of road at a cost of \$2,500 per mile. This money should be spent largely for enduring features, such as grading, drainage, etc.

The common error, however, in county bond issues is to fix the sum to be voted upon and then to demand an exorbitant mileage for that sum. There is presented in Table 5 and in Appendix C the percentage of the cost of drainage and grading, exclusive of surfacing, and the percentage of cost of the surfacing on a considerable mileage of road from several States.

Not all the surfacing need be a perishable feature. It is becoming more and more common to construct roads with surfaces built in two courses, the lower of which is regarded as a permanent feature of construction. This is particularly true of those types of road that are built with concrete foundations for bituminous-macadam, brick, or asphalt surfaces. Most hard roads are now seldom allowed to wear into the foundation course of the surfacing. It is probably conservative to regard 40 per cent of the surfacing cost of macadam or more enduring pavements as a cost for permanent features. Well-built macadam roads, from the recorded costs in Table 5, would therefore indicate a cost of 62 per cent of the total cost for permanent features and bituminous-macadam roads about 56 per cent. This method of estimating can not be applied to gravel or any natural soil road. Under most existing systems of maintenance the entire surfacing of such roads steadily deteriorates. It is generally accepted that roads built with surfaces entirely of concrete or with a brick pavement and a concrete foundation are permanent. It is not, however, yet known how long the best concrete surface will wear and it is certain that serious failures of concrete surfaces have resulted from poor construction. The best vitrified brick surfaces may have a life of 30 years or more, but repairs will usually be required and sufficiently exten-

sive data on the life of modern vitrified brick roads grouted with cement mortar are still lacking to fix the average life period.¹

The danger of building roads with little attention to anything but the surface, with no provision for repair and maintenance, and with bonds of excessive term is, however, very serious. Complete returns of highway mileage built with local bond issues are not available, but there is given in Appendix B (Tables 25 and 26) a list of bond issues and mileage constructed with the proceeds where the reports are complete.

COST OF HIGHWAY MAINTENANCE.

Highways constructed with borrowed money should be strictly maintained.² Maintenance is necessary in order to insure to the community the maximum economic service by the road and also to preserve the investment. The cost of maintenance and repairs must, therefore, be studied at the outset. Unfortunately public records do not yet present complete data on the cost of either repair or maintenance, except in certain States which have highway departments.

Well-constructed gravel roads will sometimes sustain several years of traffic without showing marked deterioration, even when there has been no maintenance. Such roads sometimes even improve during the second season; more frequently, however, they show ruts or the formation of chuck holes. It can not be expected that the average life of a gravel surface will be greater than that of a macadam surface. The average interval for resurfacing macadam roads is between six and seven years. If a sum equal to two-thirds of the original cost of the gravel surface itself is provided for renewals at six-year intervals, it should be estimated at from \$150 to \$250 per mile per year. If \$30 is then allowed for annual dragging and small repairs, the total annual cost of repair and maintenance of gravel roads would be from \$180 to \$280 per mile. The annual cost of strict maintenance is sometimes below \$30. In Bennington County, Vt., during 1912, 175 miles of gravel roads were maintained at a cost of \$20.70 per mile. The annual cost of maintenance and repair on sand-clay roads, including all necessary resurfacing at periodic intervals, should not be fixed at less than 10 per cent of the original cost.

The cost of repair and maintenance of water-bound macadam roads has been determined with considerable exactness from Massachusetts figures and checked by resurfacing charges in other States and in Germany. From \$100 to \$125 per year ordinarily pays for necessary small repairs, such as patching, cleaning culverts, etc.,

¹ For further information as to the life of roads, see Bulletin No. 48 of the Office of Public Roads, U. S. Department of Agriculture, "Repair and Maintenance of Highways," and Bulletin No. 23 of the U. S. Department of Agriculture, "Vitrified Brick as a Paving Material for Country Roads." These bulletins may be obtained from the U. S. Department of Agriculture.

² See Bulletin 48, Office of Public Roads, U. S. Department of Agriculture.

and from \$400 to \$425 per year is the necessary annual charge for resurfacing at periods varying from six to seven years. (See footnote 1, p. 12.) The sum of \$525 per mile, on an average, should therefore absolutely maintain macadam roads if changes and increases of traffic are not excessive. It must be understood, however, that in many instances where macadam sufficed for the volume and character of traffic prior to 1906, it will not withstand the action of the motor vehicle traffic which has developed since that time.

Many miles of ordinary or water-bound macadam road have been resurfaced with bituminous materials and many miles of new bituminous-macadam road have been constructed. The logical maintenance of such highways is a surface treatment with bituminous material and rock screenings, clean gravel, or sharp sand. The cost of such surface treatment is from 4 to 12 cents per square yard, and it may be expected to last from one to three years, according to the density of traffic and the success of the application. Theoretically, perfect surface treatment would constitute absolute maintenance for a bituminous-macadam road. Such maintenance is seldom or never realized and bituminous-macadam roads doubtless require resurfacing at intervals. The cost of such resurfacing is not yet known. The average cost for repair and maintenance of 7,300 miles of highway in Connecticut, Massachusetts, New York, New Jersey, and Rhode Island for the year 1912 was about \$800 per mile. A large part of this money was expended for bituminous resurfacing and bituminous surface treatment. There is some question whether the expenditure correctly measures the average cost of repairing and maintaining bituminous-macadam roads. In the State of New York, however, for the years 1911 and 1912 the average cost for repair and maintenance was \$724 per mile upon a total average of 2,861 miles. The annual cost of repair and maintenance on Massachusetts State roads for the years 1910, 1911, and 1912 was, respectively, \$642, \$647, and \$676 per mile for about 850 miles. For the most part these figures for New York and Massachusetts represent the cost per mile of resurfacing with bituminous material and of maintaining bituminous-macadam and water-bound macadam roads by surface treatment with bituminous material. It is clear, therefore, that \$700 per mile is not an excessive estimate at present for the annual cost of all repair and maintenance of bituminous-macadam roads.

The cost of maintaining concrete roads is not yet known. It is known, however, that great care must be exercised in constructing such roads to insure their success. There have been cases where such roads began to disintegrate along the wheel tracks in less than a year, owing to defective concrete. Sometimes such roads have cracked so badly that it was necessary to remove the surface entirely. In other instances the necessary repairs have been very expensive.

Instances are also known where concrete road surfaces have shown a very high percentage of annual wear. In other cases there is apparently no measurable wear. If the road surface is built with the proper mix of concrete and carefully placed, it apparently should last indefinitely and not rut. Some cleaning of the surface and patching of joints and small depressions will be necessary at all times, so that the maintenance can not be entirely neglected.

The cost of repair and maintenance upon brick highways is very low. In most instances, where the construction is as nearly perfect as possible, almost no maintenance charges have resulted. Perfect construction, however, is seldom obtained.¹ It is not unusual to find depressions and points of wear in brick roads, but it is less common than formerly. Brick roads are now usually constructed on a concrete foundation, with very carefully selected vitrified brick, and with the joints filled with cement mortar. Their annual maintenance costs, although low, are not on record with sufficient continuity to supply accurate data.

It has not been customary for officials to face frankly the cost of maintenance and repair on bond-built highways at the time the bonds are issued and before construction begins. In fact, in the majority of cases where bonds have been issued by local authorities there has been no provision whatever for maintaining the roads when built. This is perhaps the gravest defect in the project of building highways by issuing bonds. The cost of all maintenance and repair over a series of years has ranged in the past from 6 to 10 per cent of the original cost of construction on the average and varies with the type of construction. Concrete roads and brick roads apparently are a marked exception to this rule. In future construction where the type of road is properly adapted to traffic and with careful maintenance from the outset the percentage of repair and maintenance cost should be lower.

THE BOND ISSUE.

Sinking-fund bonds.—The majority of highway bonds now outstanding have been issued as straight terminable bonds to be retired by sinking funds. Many such bonds now run for excessive terms. Although the term varies from 10 to 40 years, the average is nearly 25 years.² The fund to retire the bonds is accumulated by annual installments paid by the taxpayers and is supposed to draw interest continuously and to accumulate a sufficient amount to discharge the debt at maturity. The interest which the sinking fund draws is usually from 1 to 2 per cent less than the interest paid for the loan. Five per cent highway bonds are common with the sinking fund calculated to draw $3\frac{1}{2}$ per cent interest. Table 6 shows the annual payments to the sinking fund necessary to accumulate \$1,000

¹ Cf. Bulletin 23 of the U. S. Department of Agriculture.

² Some issues—notably New York State—run 50 years. Cf. Appendices A and B.

at 3, $3\frac{1}{2}$, and 4 per cent compounded semiannually for varying periods from 1 to 30 years.

TABLE 6.—*Annual payments which, with interest at 3, $3\frac{1}{2}$, and 4 per cent, compounded semiannually, will amount to \$1,000 at the end of a term of years.*¹

Years.	Annual payments.			Years.	Annual payments.		
	3 per cent.	$3\frac{1}{2}$ per cent.	4 per cent.		3 per cent.	$3\frac{1}{2}$ per cent.	4 per cent.
1	\$1,000.0000	\$1,000.0000	\$1,000.0000	16	\$49.5229	\$47.5689	\$45.6734
2	492.5562	491.3266	490.1000	17	45.8652	43.9283	42.0537
3	323.4583	321.8368	320.2221	18	42.6221	40.7032	38.8504
4	238.9468	237.1428	235.3498	19	39.7280	37.8279	35.9976
5	188.2699	186.3672	184.4796	20	37.1306	35.2499	33.4426
6	154.5102	152.5508	150.6104	21	34.7875	32.9267	31.1429
7	130.4175	128.4252	126.4560	22	32.6639	30.8236	29.0636
8	112.3666	110.3564	108.3733	23	30.7313	28.9116	27.1759
9	98.3436	96.3254	94.3382	24	28.9656	27.1670	25.4557
10	87.1402	85.1208	83.1366	25	27.3469	25.5696	23.8829
11	77.9872	75.9717	73.9954	26	25.8582	24.1024	22.4404
12	70.3721	68.3643	66.3996	27	24.4850	22.7508	21.1136
13	63.9399	61.9427	59.9924	28	23.2149	21.5024	19.8901
14	58.4372	56.4527	54.5191	29	22.0373	20.3465	18.7591
15	53.6780	51.7080	49.7928	30	20.9428	19.2739	17.7113

¹ In Appendix D, page 98, Example 9 shows the method of calculating this table.

Table 7 illustrates how an annual sinking fund of \$32,345.83 accumulates for three years to \$100,000.

TABLE 7.—*Accumulations of an annual payment of \$32,345.83 with interest at 3 per cent compounded semiannually.*

Number of 6-month intervals.	Principal at beginning of 6-month intervals.	Interest during 6-month intervals.	Annual payment at end of 6-month intervals.	Total amount at end of 6-month intervals.
1	\$0.00	\$0.00	\$0.00	\$0.00
2	0.00	0.00	32,345.83	32,345.83
3	32,345.83	485.19	0.00	32,831.02
4	32,831.02	492.47	32,345.83	65,669.32
5	65,669.32	985.04	0.00	66,654.36
6	66,654.36	999.81	32,345.83	100,000.00

To obtain the necessary annual payments to produce any multiple of \$1 it is necessary merely to multiply the tabular value in Table 6 by the corresponding multiple; thus, an annual sinking fund payment to retire \$100,000 in 15 years at $3\frac{1}{2}$ per cent would be \$5,170.80. Table 33, pages 120 and 121, gives the yearly or periodic payments necessary to accumulate \$1 in a given number of years or periods at varying rates of interest.

There are objections to the sinking-fund method of retiring highway bonds. It may not be possible to obtain continuously the requisite rate of interest on the sinking fund to discharge the debt at maturity. The existence of the sinking fund is a constant temptation to municipal officers to use it for purposes other than the purpose originally intended. If a county, for example, issues bonds for a second object, it is easy to argue that the sinking fund already accumulated may be used to purchase the new securities, and the finances

of the community are in a way to become much confused. This is particularly true since the officers in charge of such operations are frequently changing. Sinking fund tax levies may be deferred through carelessness or under pressure of other needs. The sinking fund always requires careful attention, because it does not progress automatically in most cases.¹ It has sometimes been entirely neglected. The total cost of a bond issue retired by a sinking fund will be greater in the end than the cost of the same bond issue made by either the annuity method or by the serial method.

Annuity bonds.—By the annuity method of issuing bonds both the principal and interest are discharged by constant annual or semi-annual payments. The amount of each payment or installment is determined by the rate of interest and the term of the bond. It usually is necessary to subdivide the bond issue into individual bonds of \$100, \$500, or \$1,000 each. The resulting periodic payment of principal and interest must vary slightly because of this adjustment. Tables 8 and 9 show, in detail, the schedule of principal and interest repayments upon a loan of \$100,000 for 20 years, retired by this plan at 4 and 5 per cent per annum, respectively. The necessary adjustment to the nearest \$100 bond is also shown. It will be seen that the amount of principal retired is small at first and constantly increases while the interest charge decreases. The sum of interest and principal remains constant, and this is an advantage as the tax is then uniform.

TABLE 8.—*Repayment of a 4 per cent \$100,000 loan, including both principal and interest, by a uniform annual payment of \$7,358.175 for 20 years.*²

Years.	Adjusted to nearest cent.			Adjusted to \$100 bonds.			
	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1....	\$100,000.00	\$4,000.00	\$3,358.18	\$100,000	\$4,000	\$3,400	\$7,400
2....	96,641.82	3,865.67	3,492.50	96,600	3,864	3,500	7,364
3....	93,149.32	3,725.97	3,632.21	93,100	3,724	3,600	7,324
4....	89,517.11	3,580.68	3,777.49	89,500	3,580	3,800	7,380
5....	85,739.62	3,429.59	3,928.59	85,700	3,428	3,900	7,328
6....	81,811.03	3,272.44	4,085.73	81,800	3,272	4,100	7,372
7....	77,725.30	3,109.01	4,249.17	77,700	3,108	4,200	7,308
8....	73,476.13	2,939.05	4,419.12	73,500	2,940	4,400	7,340
9....	69,057.01	2,762.28	4,595.90	69,100	2,764	4,600	7,364
10....	64,461.11	2,578.44	4,779.73	64,500	2,580	4,800	7,380
11....	59,681.38	2,387.26	4,970.92	59,700	2,388	5,000	7,388
12....	54,710.46	2,188.42	5,169.75	54,700	2,188	5,200	7,388
13....	49,540.71	1,981.63	5,376.55	49,500	1,980	5,400	7,380
14....	44,164.16	1,766.57	5,591.60	44,100	1,764	5,600	7,364
15....	38,572.56	1,542.90	5,815.28	38,500 ¹	1,540	5,800	7,340
16....	32,757.28	1,310.29	6,047.88	32,700	1,308	6,000	7,308
17....	26,709.40	1,068.38	6,289.80	26,700	1,068	6,300	7,368
18....	20,419.60	816.78	6,541.39	20,400	816	6,500	7,316
19....	13,878.21	555.13	6,803.05	13,900	556	6,800	7,356
20....	7,075.16	283.01	7,075.16	7,100	284	7,100	7,384
Totals	.....	47,163.50	100,000.00	.....	47,152	100,000	147,152

¹ In some States there are restrictions on the nature of county investments for sinking fund purposes.

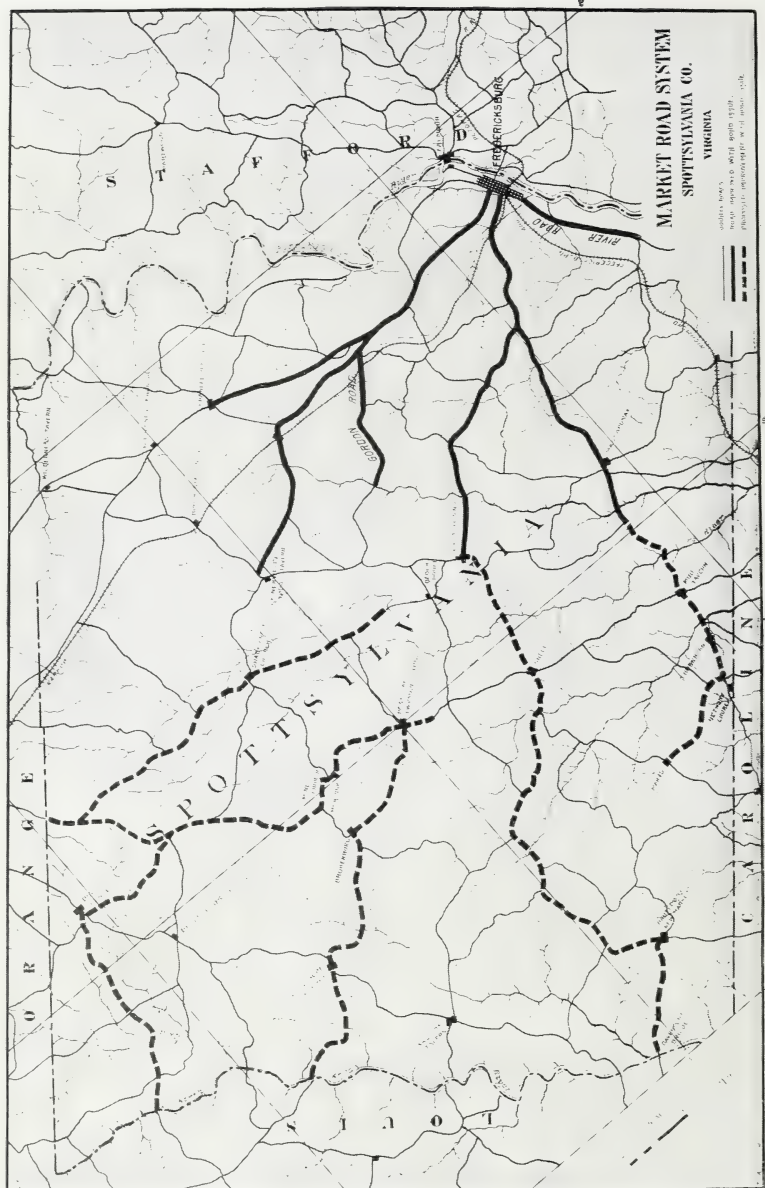
² An additional table showing the annual payments necessary to discharge a loan of \$1, with interest for varying terms and rates, is given in Table 36 on pages 126 and 127.



FIG. 1.—DALLAS COUNTY, ALA. WOODEN BRIDGE ON AN UNIMPROVED ROAD, 1 MILE NORTHWEST OF MARION JUNCTION.



FIG. 2.—DALLAS COUNTY, ALA. NEW STEEL BRIDGE WITH CONCRETE FLOOR BUILT IN 1911 TO REPLACE THE BRIDGE IN FIGURE 1.



MAP SHOWING MARKET ROAD SYSTEM, SPOTSVYLANDIA COUNTY, VA.



FIG. 1.—SPOTSYLVANIA COUNTY, VA. UNIMPROVED ROAD FROM FREDERICKSBURG TO CHANCELLORSVILLE, MARCH, 1910.



FIG. 2.—SPOTSYLVANIA COUNTY, VA. CHANCELLORSVILLE ROAD IMPROVED, MARCH, 1911.



FIG. 1.—LEE COUNTY, VA. ONE AND ONE-HALF MILES FROM JONESVILLE; NEW MACADAM ROAD BUILT FROM BOND ISSUE; OLD ROAD SHOWN AT THE RIGHT FOREGROUND.

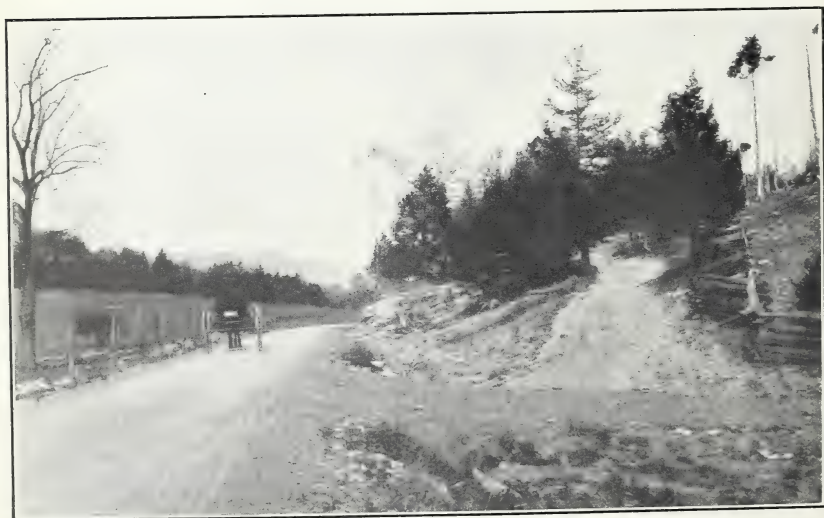


FIG. 2.—LEE COUNTY, VA. IMPROVED ROAD BUILT UNDER BOND ISSUE OF 1911 NEAR CUMBERLAND GAP; OLD ROAD IS SHOWN AT THE RIGHT.

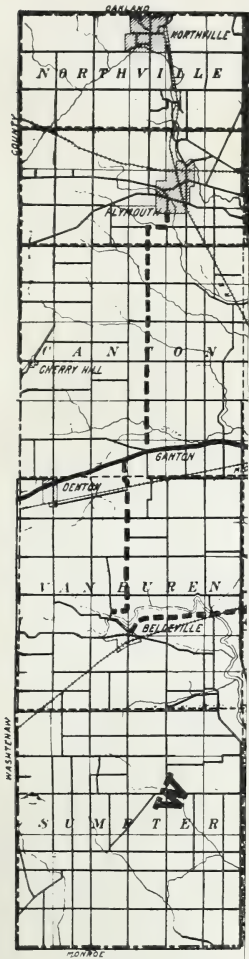






TABLE 9.—*Repayment of a 5 per cent \$100,000 loan, including both principal and interest, by a uniform annual payment of \$8,024.259¹ for 20 years.*

Adjusted to nearest cent.				Adjusted to \$100 bonds.			
Years.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	\$100,000.00	\$5,000.00	\$3,024.25	\$100,000	\$5,000	\$3,000	\$8,000
2	96,975.75	4,848.79	3,175.47	97,000	4,850	3,200	8,050
3	93,800.28	4,690.02	3,334.24	93,800	4,690	3,300	7,990
4	90,466.04	4,523.30	3,500.96	90,500	4,525	3,500	8,025
5	86,965.08	4,348.25	3,676.01	87,000	4,350	3,700	8,050
6	83,289.07	4,164.45	3,859.81	83,900	4,165	3,900	8,065
7	79,429.26	3,971.46	4,052.80	79,400	3,970	4,100	8,070
8	75,376.46	3,768.82	4,255.44	75,300	3,765	4,300	8,065
9	71,121.02	3,556.05	4,468.21	71,000	3,550	4,500	8,050
10	66,652.81	3,332.64	4,691.62	66,500	3,325	4,700	8,025
11	61,961.19	3,098.06	4,926.19	61,800	3,090	4,900	7,990
12	57,035.00	2,851.75	5,172.51	56,900	2,845	5,200	8,045
13	51,862.49	2,593.13	5,431.13	51,700	2,585	5,400	7,985
14	46,431.36	2,321.57	5,702.69	46,300	2,315	5,700	8,015
15	40,728.67	2,036.43	5,987.83	40,600	2,030	6,000	8,030
16	34,740.84	1,737.04	6,287.22	34,600	1,730	6,300	8,030
17	28,453.62	1,422.68	6,601.58	28,300	1,415	6,600	8,015
18	21,852.04	1,092.60	6,931.66	21,700	1,085	6,900	7,985
19	14,920.38	746.02	7,278.24	14,800	740	7,200	7,940
20	7,642.14	382.12	7,642.14	7,600	380	7,600	7,980
Totals	.....	60,485.18	100,000.00	.....	60,405	100,000	160,405

¹Cf. Example 14, p. 101, for details of calculations.

Serial bonds.—The serial bond differs somewhat from the annuity bond, because, instead of keeping the annual payment of both principal and interest constant, the principal alone retired each year remains fixed. This type of bond has become more common for highway purposes in recent years, and during 1912 and 1913 the number of serial issues exceeded the number of issues for any other single given term. The Office of Public Roads received reports for these two years of \$15,300,819 in serial highway bonds, which is over 20 per cent of the total county and district bonds for which the period or term of issue was reported. In Tables 10 and 11 are given the necessary annual payments of interest and principal for an issue of \$100,000 for 20 years at 4 and 5 per cent, respectively, where the bonds are retired by annual payments of \$5,000 each. The first retirement is sometimes deferred for a number of years.

TABLE 10.—*Schedule of interest and principal to retire a serial loan of \$100,000 at 4 per cent, with annual principal repayments of \$5,000.*

Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.	Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	\$100,000	\$4,000	\$5,000	\$9,000	12	\$45,000	\$1,800	\$5,000	\$6,800
2	95,000	3,800	5,000	8,800	13	40,000	1,600	5,000	6,600
3	90,000	3,600	5,000	8,600	14	35,000	1,400	5,000	6,400
4	85,000	3,400	5,000	8,400	15	30,000	1,200	5,000	6,200
5	80,000	3,200	5,000	8,200	16	25,000	1,000	5,000	6,000
6	75,000	3,000	5,000	8,000	17	20,000	800	5,000	5,800
7	70,000	2,800	5,000	7,800	18	15,000	600	5,000	5,600
8	65,000	2,600	5,000	7,600	19	10,000	400	5,000	5,400
9	60,000	2,400	5,000	7,400	20	5,000	200	5,000	5,200
10	55,000	2,200	5,000	7,200					
11	50,000	2,000	5,000	7,000	Totals	.....	42,000	100,000	142,000

TABLE 11.—*Schedule of interest and principal to retire a serial loan of \$100,000 at 5 per cent, with annual principal repayments of \$5,000.*

Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.	Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	\$100,000	\$5,000	\$5,000	\$10,000	12	\$45,000	\$2,250	\$5,000	\$7,250
2	95,000	4,750	5,000	9,750	13	40,000	2,000	5,000	7,000
3	90,000	4,500	5,000	9,500	14	35,000	1,750	5,000	6,750
4	85,000	4,250	5,000	9,250	15	30,000	1,500	5,000	6,500
5	80,000	4,000	5,000	9,000	16	25,000	1,250	5,000	6,250
6	75,000	3,750	5,000	8,750	17	20,000	1,000	5,000	6,000
7	70,000	3,500	5,000	8,500	18	15,000	750	5,000	5,750
8	65,000	3,250	5,000	8,250	19	10,000	500	5,000	5,500
9	60,000	3,000	5,000	8,000	20	5,000	250	5,000	5,250
10	55,000	2,750	5,000	7,750	Totals.	-----	52,500	100,000	152,500
11	50,000	2,500	5,000	7,500					

Comparison of serial, annuity, and sinking-fund bonds.—

It will be noticed that the total expense to the community under the serial plan is somewhat less than under the annuity plan. The expense by either method is, however, considerably less than the expense under the sinking-fund plan. For the purpose of comparison the total expense to the community under each plan is assembled under Table 12.

Tables 8 to 11, inclusive, are computed with interest payable annually. Bonds with interest payable semiannually sell better. Similar tables or schedules for the annuity and serial plans of bond issues to conform to semiannual interest payments can be easily prepared. Schedules can also be prepared to show the progress of a bond loan when the bonds are bought at a premium or discount.¹

TABLE 12.—*Total cost of a loan of \$100,000 for 20 years, interest compounded annually.*

Annual interest on bonds.	Sinking fund compounded annually at—			Annuity.	Serial.
	3 per cent.	3½ per cent.	4 per cent.		
4	\$154,431	\$150,722	\$147,163	\$147,163	\$142,000
4½	164,431	160,722	157,163	153,752	147,250
5	174,431	170,722	167,163	160,485	152,500
5½	184,431	180,722	177,163	167,359	157,750
6	194,431	190,722	187,163	174,369	163,000

In a bond issue by any given plan the amount, the interest, and the term may be fixed at will, but when this is done the annual repayments of principal and interest are theoretically determined. Thus, by the annuity method, if \$100,000 is to be issued at 5 per cent annually and retired in 20 years, the annual amount of interest and principal is at once determined to be approximately \$8,000.

¹ Cf. Appendix D, pages 91 to 115, for details of such schedules.

For the same bond issue under the serial plan, the total annual payment varies because the interest varies, but each yearly payment of interest and principal is nevertheless fixed.

Under the sinking-fund plan the annual payment necessary for principal and interest is theoretically constant, but it depends upon the interest realized upon the sinking fund. It is not safe, as a rule, to estimate this interest at more than $3\frac{1}{2}$ per cent. Then for a \$100,000 20-year loan, with annual interest on the sinking fund, the total annual payment would be \$8,536.11. If the sinking fund could earn the rate of interest which is paid upon the loan there would be no advantage in expense to the community in the annuity or the serial bond over the sinking-fund bond. There is given in Table 13 the total mill tax on \$1 to retire a bond issue of \$100,000 by the sinking fund or the annuity plan.

TABLE 13.—*Annual mill tax on \$1 for interest and retirement on a bond issue of \$100,000, at 5 per cent annual interest, for terms of 10 and 20 years.*

Valuation.	Mill tax.							
	10 years.				20 years.			
	Sinking-fund plan. ¹			Annuity plan. ²	Sinking-fund plan. ¹			Annuity plan. ²
	3 per cent.	$3\frac{1}{2}$ per cent.	4 per cent.		3 per cent.	$3\frac{1}{2}$ per cent.	4 per cent.	
\$1,000,000	13.723	13.524	13.329	12.950	8.722	8.536	8.358	8.024
1,500,000	9.149	9.016	8.886	8.634	5.814	5.691	5.572	5.350
2,000,000	6.861	6.762	6.665	6.475	4.361	4.268	4.179	4.012
2,500,000	5.489	5.410	5.332	5.180	3.489	3.414	3.343	3.210
3,000,000	4.574	4.508	4.443	4.317	2.907	2.845	2.786	2.675
3,500,000	3.921	3.864	3.808	3.700	2.492	2.439	2.388	2.293
4,000,000	3.431	3.381	3.332	3.238	2.180	2.134	2.090	2.006
4,500,000	3.050	3.005	2.962	2.878	1.938	1.897	1.857	1.783
5,000,000	2.745	2.705	2.666	2.590	1.744	1.707	1.672	1.605
5,500,000	2.495	2.459	2.423	2.355	1.586	1.552	1.520	1.459
6,000,000	2.287	2.254	2.222	2.158	1.454	1.423	1.393	1.337
6,500,000	2.111	2.081	2.051	1.992	1.342	1.313	1.286	1.235
7,000,000	1.960	1.932	1.904	1.850	1.246	1.219	1.194	1.146
7,500,000	1.830	1.803	1.777	1.727	1.163	1.138	1.114	1.070
8,000,000	1.715	1.691	1.666	1.619	1.090	1.067	1.045	1.003
8,500,000	1.614	1.591	1.568	1.524	1.026	1.004	.983	.944
9,000,000	1.525	1.503	1.481	1.439	.969	.948	.929	.892
9,500,000	1.445	1.424	1.403	1.363	.918	.899	.880	.845
10,000,000	1.372	1.352	1.333	1.295	.872	.854	.836	.802

¹ With interest compounded annually.

² The tax for the serial plan is slightly less, but varies from year to year.

It is quite probable that so many 30-year bonds are issued in order to take advantage of the fact that bonds of that term result in a low annual charge for interest and sinking fund. It will be seen from Table 14 that very little advantage is gained by fixing the term of a bond longer than 30 years. The annual charge decreases very slowly from that point, whereas the total charge increases rapidly.

TABLE 14.—*Annual and total costs of a loan of \$100,000 for varying periods, with sinking fund to draw 3½ per cent interest, compounded annually.*

Term in years.	Annual interest on bonds.			
	4 per cent.		5 per cent.	
	Total annual payment, interest, and sinking fund.	Total cost of loan.	Total annual payment, interest, and sinking fund.	Total cost of loan.
5	\$22,648	\$113,241	\$23,648	\$118,241
10	12,524	125,241	13,524	135,241
15	9,183	137,738	10,183	152,738
20	7,536	150,722	8,536	170,722
25	6,567	164,185	7,567	189,185
30	5,937	178,114	6,937	208,114
35	5,500	192,494	6,500	227,494
40	5,183	207,309	6,183	247,309
45	4,945	222,540	5,945	267,540
50	4,763	238,169	5,763	288,169

The same facts are presented in the diagram of Plate III, figure 1. The curves of annual cost of interest and retirement fall very slowly after the 30-year point.

It is an unfortunate fact that most highways do not have a life of 30 years, and it is now quite evident that the life of the highway and not the apparent economic term of the bond should determine the length of the loan. Many miles of natural soil roads are annually built by 30-year bond issues. There is usually no provision for repair and maintenance charges, and little business organization in the county road system. This practice is financially dangerous. No gravel road surface can last 30 years,¹ and apparently the only road surfaces for which a 30-year life is recorded are surfaces of far more expensive construction than are usually built under the bond issues reported to the Office of Public Roads.

There is a further advantage in the annuity or serial bond for highway construction, because it is more likely under such a bond that the road surface will be paid for before it is entirely worn out. If an annuity or serial bond begins to mature immediately, this is not considered a serious objection among bankers. These types of bonds are particularly adapted for financing operations which by their very nature involve a wasting of the property. A highway is in part a wasting property and it is desirable to have established a margin of safety in highway financing. Railroads frequently issue serial equipment bonds for a period of 10 years with which to purchase rolling stock. The amount of bonds retired annually is carefully adjusted so that the retirement is faster than the depreciation of the rolling stock. The difference between the outstanding bonds and the value of the equipment in any year is the margin of safety.

¹ Massachusetts in 1912 reduced the term of State highway bonds from 30 to 15 years. Wisconsin passed a law, effective in 1913, providing that counties may issue 5 per cent bonds for State highways for periods not to exceed 10 years. The bonds must be serial bonds, with interest and redemption fund to be raised by direct taxation.

From the nature of the annuity or the serial form of highway bonds it is never necessary to issue new or refunding bonds at the end of the term. Both of these types of bonds have the advantage that they accomplish with one financial operation all that the sinking-fund type of bond can accomplish. The main advantage, however, of both types of bonds is that the community saves more money than under the sinking-fund plan because it avoids paying a higher rate on borrowed money than it can obtain on money that it loans.

Highway bonds are seldom sold at par. Not infrequently they command a slight premium; that is to say, they are sold at an advance over the par value. In nearly every State the law provides that municipal bonds shall not be sold at less than par.¹ When the purchaser pays a premium for a 5 per cent highway bond it will yield less than 5 per cent. To enable investors to determine quickly the net rate of yield from a bond purchased at a premium or at a discount, tables known as bond tables have been calculated. In Appendix D is presented a short bond table of this kind (Table 37). From this table the net yield of a bond with a nominal rate of interest of from 3 to 6 per cent, payable semiannually and for varying terms, may be calculated for various prices. Thus a 5 per cent 15-year highway bond purchased at 103.20, or with a premium of 3.20 per cent, will be found to yield the purchaser 4.70 per cent on his investment.² Such tables are of more important interest to the purchaser than to the municipality offering the bonds, but they are necessary for the intelligent direction of the bond issue.

In calculating the price to be paid for serial bonds, it is customary to treat each series separately and to find the price that yields the given net rate by adding the separate prices. Some formulas will be found, however, in Appendix D which considerably shorten the labor of calculating the price to be paid for serial bonds and the labor of related calculations.

Special form of annuity bond.—In the operation of the annuity bond both interest and principal are discharged by a series of equal installments, usually semiannual. Each installment contains interest on the bonds outstanding at the beginning of the interval and the balance is applied to retire the bonds. The effect of this method is to diminish steadily the investment of the purchaser. If, however, the borrower should arrange to set aside periodically in a sinking fund a fixed sum *in excess of the periodic interest on the entire issue*, the effect would be to leave the total investment of the purchaser undisturbed until the sinking fund had accumulated to the amount of the loan. When the excess of the periodic installment over the required interest is arbitrarily selected and accumulates at a given rate of

¹ Massachusetts requires the premium to be deposited in the sinking fund. To avoid paying par value for the bonds, bidders frequently bid par or above par and require an allowance for attorney's fees and expenses.

²Cf. Appendix D, page 129.

interest, the term of the bond is thereby absolutely fixed. A simple way to accomplish this result is to add to the nominal interest rate which the bonds pay a percentage of the principal to be set aside in a sinking fund to retire the bonds. There is produced thus a new nominal rate. Since both interest and principal are discharged by the periodical payment of interest or dividends at the new nominal rate, an issue of this character may be described as a special form of annuity bond.

Table 15 shows the resulting terms in years of a bond issue for \$1,000,000 where from $1\frac{1}{2}$ to one-half per cent of the principal is set aside semiannually in a sinking fund which draws 3 per cent compounded semiannually. The original interest rate on the bonds is assumed to be 3 per cent, payable semiannually, and the new increased nominal rate varies then from 6 to 4 per cent. The last column shows the total cost to the borrower for the loan of \$1,000,000 under this method.

TABLE 15.—*Necessary terms and total costs of a bond issue of \$1,000,000 at 3 per cent, payable semiannually, when retired by various arbitrary fractions of the principal set aside and compounded semiannually.*

Applied semiannually to sinking fund to retire bond issue.	New increased interest rate on original 3% bonds.	Term of bonds.	Total cost to borrower.
<i>Per cent. of loan.</i>	<i>Per cent.</i>	<i>Years.</i>	<i>Dollars.</i>
$1\frac{1}{2}$	6	$23\frac{1}{2}$	1,410,000
$1\frac{5}{8}$	$5\frac{3}{4}$	25	1,437,500
$1\frac{1}{4}$	$5\frac{1}{2}$	$26\frac{1}{2}$	1,457,500
$1\frac{3}{8}$	$5\frac{1}{4}$	$28\frac{1}{2}$	1,496,250
1	5	31	1,550,000
$\frac{7}{8}$	$4\frac{3}{4}$	34	1,615,000
$\frac{3}{4}$	$4\frac{1}{2}$	37	1,665,000
$\frac{5}{8}$	$4\frac{1}{4}$	$41\frac{1}{2}$	1,763,750
$\frac{1}{2}$	4	47	1,880,000
$\frac{1}{2}$	4	50	2,000,000

The progress of the accumulation of the semiannual sinking fund under the plan here outlined is shown for varying retirement rates in Table 17. It is possible so to determine the rate of retirement that the resulting term of the bonds is integral instead of fractional. The increased nominal rates for 3 per cent bonds to retire in varying integral terms is as follows:¹

TABLE 16.—*Equivalent nominal rates for retiring 3 per cent bonds in varying terms.*

	Per cent.		Per cent.
10 years.....	11.649148	30 years.....	5.078686
20 years.....	6.685420	40 years.....	4.309664
25 years.....	5.714336	50 years.....	3.874114

¹ This rate per cent is determined by the formula:

$$\text{Rate per cent} = 3 + 200/S_{2n}$$

where n is the number of years S_{2n} is determined from Table 32, Appendix D, at the rate $1\frac{1}{2}\%$.

TABLE 17.—Accumulations at 3 per cent, convertible semiannually, of a semiannual sinking fund to extinguish a loan of \$1,000,000.

New increased nominal rate on original 3% bonds.	Years.	4 per cent.	4½ per cent.	4¾ per cent.	5 per cent.	5½ per cent.	5¾ per cent.	6 per cent.
		Percentage which the semiannual sinking-fund payment bears to the loan.						
		½ per cent.	¾ per cent.	1 per cent.	1¼ per cent.	1½ per cent.	1¾ per cent.	1½ per cent.
0.5		\$5,000.00	\$6,250.00	\$8,750.00	\$10,000.00	\$11,250.00	\$12,500.00	\$13,750.00
1.0		10,000.00	12,500.00	17,612.50	20,156.25	22,698.75	25,187.50	27,706.25
1.5		15,000.00	19,032.66	26,615.72	30,452.25	34,258.78	38,065.31	41,871.84
2.0		20,000.00	25,368.15	36,081.78	40,949.63	46,022.66	51,136.29	56,249.92
2.5		25,000.00	32,043.61	45,618.81	52,027.22	59,095.62	66,249.92	73,402.18
3.0		30,000.00	39,087.22	57,247.50	65,639.55	75,079.48	84,399.25	93,519.02
3.5		35,000.00	46,592.92	69,322.09	80,386.98	92,637.55	105,688.72	118,939.59
4.0		40,000.00	54,544.36	81,812.80	95,519.40	110,597.33	126,681.14	142,769.02
4.5		45,000.00	62,941.57	94,724.75	109,937.65	126,975.43	144,395.06	162,519.59
5.0		50,000.00	71,784.60	108,134.48	126,156.90	146,146.52	165,378.71	186,249.02
5.5		55,000.00	81,087.76	121,699.89	141,812.80	163,256.38	185,955.22	207,769.02
6.0		60,000.00	90,941.57	136,611.70	158,820.44	184,955.22	211,377.40	230,249.02
6.5		65,000.00	101,341.57	153,087.22	176,156.90	201,688.72	230,249.02	254,769.02
7.0		70,000.00	112,387.22	170,941.57	195,688.72	223,249.02	254,769.02	280,249.02
7.5		75,000.00	124,087.22	190,412.80	217,156.90	247,769.02	280,249.02	306,769.02
8.0		80,000.00	136,544.36	211,699.89	241,812.80	274,395.06	308,249.02	334,249.02
8.5		85,000.00	149,857.22	234,724.75	267,688.72	303,249.02	337,769.02	363,769.02
9.0		90,000.00	164,024.36	259,724.75	294,688.72	334,249.02	369,249.02	395,249.02
9.5		95,000.00	179,057.22	286,724.75	323,249.02	368,249.02	403,249.02	429,769.02
10.0		100,000.00	194,941.57	315,544.36	354,249.02	400,249.02	439,249.02	465,769.02
10.5		105,000.00	211,687.22	347,247.50	387,769.02	440,249.02	477,249.02	503,769.02
11.0		110,000.00	229,392.92	381,812.80	423,769.02	484,249.02	517,249.02	543,769.02
11.5		115,000.00	248,057.22	418,322.09	462,249.02	524,249.02	559,249.02	585,769.02
12.0		120,000.00	267,688.72	454,769.02	502,249.02	568,249.02	603,249.02	629,769.02
12.5		125,000.00	288,249.02	493,249.02	542,249.02	609,249.02	644,249.02	671,769.02
13.0		130,000.00	309,769.02	533,769.02	582,249.02	652,249.02	687,249.02	714,769.02
13.5		135,000.00	332,249.02	575,249.02	626,249.02	697,249.02	734,249.02	758,769.02
14.0		140,000.00	355,769.02	618,769.02	671,249.02	747,249.02	779,249.02	803,769.02
14.5		145,000.00	380,249.02	664,249.02	717,249.02	802,249.02	834,249.02	860,249.02
15.0		150,000.00	405,769.02	711,249.02	764,249.02	857,249.02	890,249.02	924,249.02
15.5		155,000.00	432,249.02	759,249.02	813,249.02	907,249.02	941,249.02	976,249.02
16.0		160,000.00	459,769.02	808,249.02	864,249.02	966,249.02	1,000,249.02	1,035,249.02
16.5		165,000.00	488,249.02	859,249.02	917,249.02	1,021,249.02	1,056,249.02	1,091,249.02
17.0		170,000.00	517,769.02	914,249.02	970,249.02	1,082,249.02	1,117,249.02	1,152,249.02
17.5		175,000.00	548,249.02	973,249.02	1,025,249.02	1,135,249.02	1,170,249.02	1,205,249.02
18.0		180,000.00	579,769.02	1,034,249.02	1,080,249.02	1,190,249.02	1,225,249.02	1,260,249.02
18.5		185,000.00	612,249.02	1,097,249.02	1,137,249.02	1,247,249.02	1,282,249.02	1,317,249.02
19.0		190,000.00	646,769.02	1,167,249.02	1,197,249.02	1,307,249.02	1,342,249.02	1,377,249.02
19.5		195,000.00	682,249.02	1,239,249.02	1,259,249.02	1,369,249.02	1,407,249.02	1,442,249.02
20.0		200,000.00	719,769.02	1,313,249.02	1,324,249.02	1,434,249.02	1,474,249.02	1,514,249.02
20.5		205,000.00	758,249.02	1,390,249.02	1,392,249.02	1,503,249.02	1,545,249.02	1,585,249.02
21.0		210,000.00	798,769.02	1,469,249.02	1,463,249.02	1,574,249.02	1,617,249.02	1,659,249.02
21.5		215,000.00	840,249.02	1,551,249.02	1,534,249.02	1,647,249.02	1,692,249.02	1,734,249.02
22.0		220,000.00	883,769.02	1,636,249.02	1,601,249.02	1,722,249.02	1,768,249.02	1,812,249.02
22.5		225,000.00	929,249.02	1,724,249.02	1,668,249.02	1,803,249.02	1,850,249.02	1,895,249.02
23.0		230,000.00	976,769.02	1,815,249.02	1,737,249.02	1,887,249.02	1,935,249.02	1,981,249.02
23.5		235,000.00	1,026,249.02	1,909,249.02	1,808,249.02	1,978,249.02	2,027,249.02	2,074,249.02
24.0		240,000.00	1,078,249.02	2,006,249.02	1,882,249.02	2,072,249.02	2,122,249.02	2,169,249.02
24.5		245,000.00	1,132,249.02	2,107,249.02	1,959,249.02	2,169,249.02	2,214,249.02	2,260,249.02
25.0		250,000.00	1,188,249.02	2,212,249.02	2,039,249.02	2,269,249.02	2,317,249.02	2,363,249.02
25.5		255,000.00	1,246,249.02	2,320,249.02	2,122,249.02	2,372,249.02	2,418,249.02	2,464,249.02
26.0		260,000.00	1,306,249.02	2,431,249.02	2,208,249.02	2,479,249.02	2,517,249.02	2,563,249.02
26.5		265,000.00	1,368,249.02	2,545,249.02	2,297,249.02	2,589,249.02	2,618,249.02	2,664,249.02
27.0		270,000.00	1,432,249.02	2,662,249.02	2,389,249.02	2,692,249.02	2,721,249.02	2,767,249.02
27.5		275,000.00	1,498,249.02	2,782,249.02	2,484,249.02	2,799,249.02	2,826,249.02	2,872,249.02
28.0		280,000.00	1,566,249.02	2,905,249.02	2,582,249.02	2,910,249.02	2,937,249.02	2,983,249.02
28.5		285,000.00	1,636,249.02	3,031,249.02	2,683,249.02	3,024,249.02	3,052,249.02	3,098,249.02
29.0		290,000.00	1,708,249.02	3,160,249.02	2,787,249.02	3,141,249.02	3,170,249.02	3,216,249.02
29.5		295,000.00	1,782,249.02	3,292,249.02	2,894,249.02	3,262,249.02	3,292,249.02	3,343,249.02
30.0		300,000.00	1,858,249.02	3,427,249.02	3,004,249.02	3,386,249.02	3,417,249.02	3,471,249.02
30.5		305,000.00	1,936,249.02	3,565,249.02	3,117,249.02	3,513,249.02	3,545,249.02	3,591,249.02
31.0		310,000.00	2,016,249.02	3,706,249.02	3,233,249.02	3,643,249.02	3,676,249.02	3,722,249.02
31.5		315,000.00	2,098,249.02	3,850,249.02	3,352,249.02	3,775,249.02	3,807,249.02	3,853,249.02
32.0		320,000.00	2,182,249.02	3,997,249.02	3,474,249.02	3,913,249.02	3,947,249.02	3,993,249.02
32.5		325,000.00	2,268,249.02	4,147,249.02	3,599,249.02	4,052,249.02	4,086,249.02	4,132,249.02
33.0		330,000.00	2,356,249.02	4,300,249.02	3,727,249.02	4,194,249.02	4,232,249.02	4,278,249.02
33.5		335,000.00	2,446,249.02	4,456,249.02	3,858,249.02	4,340,249.02	4,379,249.02	4,425,249.02
34.0		340,000.00	2,538,249.02	4,615,249.02	3,999,249.02	4,489,249.02	4,529,249.02	4,575,249.02
34.5		345,000.00	2,632,249.02	4,777,249.02	4,143,249.02	4,641,249.02	4,681,249.02	4,727,249.02
35.0		350,000.00	2,728,249.02	4,939,249.02	4,290,249.02	4,796,249.02	4,836,249.02	4,882,249.02
35.5		355,000.00	2,826,249.02	5,104,249.02	4,440,249.02	4,954,249.02	4,990,249.02	5,036,249.02
36.0		360,000.00	2,926,249.02	5,272,249.02	4,594,249.02	5,115,249.02	5,151,249.02	5,197,249.02
36.5		365,000.00	3,028,249.02	5,443,249.02	4,751,249.02	5,279,249.02	5,317,249.02	5,363,249.02
37.0		370,000.00	3,132,249.02	5,617,249.02	4,911,249.02	5,446,249.02	5,485,249.02	5,531,249.02
37.5		375,000.00	3,238,249.02	5,794,249.02	5,074,249.02	5,617,249.02	5,656,249.02	5,702,249.02
38.0		380,000.00	3,346,249.02	5,974,249.02	5,240,249.02	5,791,249.02	5,832,249.02	5,878,249.02
38.5		385,000.00	3,456,249.02	6,157,249.02	5,409,249.02	5,969,249.02	6,011,249.02	6,057,249.02
39.0		390,000.00	3,568,249.02	6,343,249.02	5,581,249.02	6,150,249.02	6,193,249.02	6,239,249.02
39.5		395,000.00	3,682,249.02	6,532,249.02	5,756,249.02	6,334,249.02	6,377,249.02	6,423,249.02
40.0		400,000.00	3,798,249.02	6,724,249.02	5,934,249.02	6,521,249.02	6,565,249.02	6,611,249.02
40.5		405,000.00	3,916,249.02	6,919,249.02	6,116,249.02	6,712,249.02	6,757,249.02	6,803,249.02
41.0		410,000.00	4,036,249.02	7,117,249.02	6,302,249.02	6,906,249.02	6,952,249.02	7,000,249.02
41.5		415,000.00	4,158,249.02	7,318,249.02	6,491,249.02	7,104,249.02	7,151,249.02	7,200,249.02
42.0		420,000.00	4,282,249.02	7,522,249.02	6,684,249.02	7,306,249.02	7,354,249.02	7,403,249.02
42.5		425,000.00	4,408,249.02	7,729,249.02	6,880,249.02	7,511,249.02	7,560,249.02	7,610,249.02
43.0		430,000.00	4,536,249.02	7,939,249.02	7,079,249.02	7,719,249.02	7,769,249.02	7,820,249.02
43.5		435,000.00	4,666,249.02	8,151,249.02	7,281,249.02	7,930,249.02	7,981,249.02	8,033,249.02
44.0		440,000.00	4,798,249.02	8,366,249.02	7,486,249.02	8,144,249.02	8,196,249.02	8,249,249.02
44.5		445,000.00	4,932,249.02	8,583,249.02	7,694,249.02	8,361,249.02	8,414,249.02	8,467,249.02
45.0		450,000.00	5,068,249.02	8,803,249.02	7,905,249.02	8,581,249.02	8,634,249.02	8,687,249.02
45.5		455,000.00	5,206,249.02	9,024,249.02	8,119,249.02	8,804,249.02	8,858,249.02	8,912,249.02
46.0		460,000.00	5,346,249.02	9,247,249.02	8,33			

The details of advertising and selling highway bonds are frequently prescribed by law. Bids from bond houses are always made conditioned on an investigation of the validity of all proceedings leading to the issue. The attorneys for the bidders will require from the municipality certified copies of all papers concerning the transaction. There frequently is much variation in the form of the bids for a single issue. The items of denomination of the bonds, options on delivery, portion of the issue bid for, deposit of the money in stipulated banks, and items of less importance are often written into the bids.

TOTAL COST OF HIGHWAYS.

Charges included in total cost.—The first cost of construction is not the total cost of a highway. It is becoming customary to consider the cost of highways for a period of years.¹ This view of highway costs is important in the construction of highways with borrowed money. Municipal or county bonds are invariably issued for a definite term or period, and it is desirable, therefore, to know the total cost to a community during the life of the bond. Undoubtedly the best financial policy is to restrict the term of the highway bond to the probable useful life of the original type of road under actual conditions.

There is considerable difference of opinion among engineers and highway officials as to what constitutes the total cost of a highway during a given period of years. Questions arise over the interest charge on the original cost, the annual payments to amortize or retire the loan, the depreciation charge, and the repair and maintenance charge. Evidently if a repair and maintenance charge is made sufficient to maintain the road *absolutely* for an indefinite period, a depreciation charge has no place in the estimate of total annual cost. It is also apparent that total and annual costs for the loan can be made to vary at will by changing the period of the loan, i. e., the term of the bond. To make the problem more definite, it is desirable to assume, first, that the highway loan is a terminable loan and for a period not greater than the period for which the road will continue to serve with the original type of surface, grade, and alignment; and, second, that there is charged as the total cost of the road for that period all money paid by the community for that road in the form of taxes.

Although the cost of resurfacing a road or extraordinary repairs is a cost which occurs only at intervals, it is a safe and conservative plan to make an annual charge for all such work. As an example, if a water-bound macadam road is built at a cost of \$8,000 per mile

¹ Cf., for example, the report of the Cambridge (Mass.) Paving Commission, June, 1911, and the 1909 Report of Public Work in Cuyahoga County, Ohio, p. 21.

with money borrowed at 5 per cent for 15 years and retired by a sinking fund, there would result the following annual expense to the taxpayers for each mile for 15 years: Interest on \$8,000 at 5 per cent, \$400; annual sinking fund to retire \$8,000 in 15 years, at $3\frac{1}{2}$ per cent interest compounded semiannually, \$413.66;¹ cost of annual maintenance, \$125; annual cost of periodic² resurfacing, \$400—making a total annual cost of \$1,338.66. By the annuity bond plan, the expenses would be: Annual repayments of interest and principal,³ \$770.74; cost of annual maintenance, \$125; annual cost of periodic² resurfacing, \$400—making a total annual cost of \$1,295.74.

At the end of 15 years the interest and redemption charges cease, and if resurfacing is carried out as planned the surface is but two years old and the community has a property the permanent value of which represents at least 62 per cent of the original cost, or \$4,960, exclusive of the surface, and an accumulation of \$800 toward resurfacing. If the road is to continue in its original form, the annual charge for repairs and maintenance will probably increase because of increased traffic. If the annual payment of principal is reduced by extending the period of the loan, there is danger that a new loan will be necessary for more expensive construction to meet the increasing traffic before the original loan is retired. Moreover, the decrease in annual payments of interest and principal is not inversely as the increase in the period of the loan. A 30-year 5 per cent annuity bond would require an annual payment of \$520.41 per mile on the \$8,000 macadam road above cited. (See Table 36 and Pl. III, fig. 1.)

If the same method of estimating the annual cost is used for each type of road considered, the relative total cost of the various types may be computed fairly and without confusion. If a highway were built from cash in the public treasury it would theoretically still be necessary to include in the annual cost of such a highway the interest on the first cost of construction at a rate which the municipality or county could obtain by investment of its funds. The question of how long such interest should run has never been determined.⁴

In estimating the total cost of a highway for a series of years the cost of repair and maintenance is the item most frequently neglected.⁵ The cost of the sinking fund or the charge for bond redemption is also sometimes forgotten. There are now outstanding bonds for highway construction where no provision has been made to retire them, although the bonds have been issued for a definite term.

¹ Use Table 6, p. 15.

² At intervals of 6.5 years, at \$2,600 per mile, or 29.5 cents per square yard for a 15-foot road; no allowance of interest is made; for discussion of this point, see p. 13.

³ See Table 36, Appendix D.

⁴ Theoretically interest would run until improved road had paid for itself by saving to community.

⁵ In one county of Virginia, after public highways had been constructed from the proceeds of a bond issue, the county established tollgates upon the highways in order to raise revenue for their maintenance.

Financing maintenance.—It is undoubtedly necessary, in general, to establish a direct tax for annual repair and maintenance for bond-built highways.¹ When highway bonds are issued it should be distinctly understood that there will be (besides the tax for interest and retirement) within a few years an additional tax for repair and maintenance, if the regular road tax within the county, as is most often likely, is not already sufficient to repair and maintain the new roads. This repair and maintenance charge is inevitable and, since the earning power of the road in reducing hauling costs tends to increase with the degree of maintenance, it is sound business to face the repair and maintenance charges in the beginning.

Comparisons of total costs.—When the more expensive types of highways are to be built by the proceeds of a bond issue, especially under increasing traffic, a question may fairly arise as to the relative portions of the total cost for a series of years, which should be devoted to repair and maintenance and to first construction and interest. As Table 5 shows, the cost of the hard highway surface constitutes, for standard types of construction, the largest percentage of total costs.

Up to a certain point, when the cost of the surface is increased, the cost per mile of maintenance correspondingly increases, but not usually the cost per unit of traffic. It costs more per mile to repair and maintain an ordinary macadam road, for example, than it does to repair and maintain a gravel road, and the cost per mile of repair and maintenance for bituminous-macadam roads is greater than for ordinary macadam roads. The costs of repair and maintenance of the best-built brick and concrete roads are apparently very low, and would, therefore, not follow the above rule.

The total necessary cost of a highway for a series of years can be determined only approximately and only after a study of the character and volume of traffic and a comparison of the total probable costs for the kinds of surface adapted to the traffic. It may not be economy to build a road of cheap first cost and high maintenance charges. If exact figures were available, accurate comparisons of different surfaces would be simple, but many items are still lacking. It is not known how long a concrete road will wear or what it will cost to renew it, especially if it has to be broken up and removed. The life of bituminous-macadam roads has not yet been fully determined, nor has the life of the best modern vitrified brick pavement. Absolute maintenance² on most pavements can seldom be continuous. Repairs or resurfacing operations will be needed at intervals which are as yet imperfectly determined.

¹ Cf. Act of September, 1913, by Legislature of Tennessee, which establishes a maintenance tax of 2 per cent of all highway bonds.

² See Bulletin No. 48 of the Office of Public Roads, p. 8.

If it is assumed that a 15-foot bituminous-macadam road costs \$10,500 a mile, and the corresponding 15-foot brick road \$18,500 a mile, with annual (absolute) maintenance for the bituminous road at \$600 per year and strict maintenance¹ for the brick road \$300 per year, the necessary items for the total cost for 20 years may be stated as follows:

Bituminous-macadam:

Cost of construction (\$10,500) under 5 per cent serial bond with interest for 20 years ²	\$16,012. 50
Cost of annual repair and maintenance (\$600) for 20 years.....	12,000. 00
Total cost for 20 years.....	28,012. 50

Brick:

Cost of construction (\$18,500) under 5 per cent serial bond with interest for 20 years ²	\$28,212. 50
Cost of annual repair and maintenance (\$300) for 20 years.....	6,000. 00
Total cost for 20 years.....	34,212. 50

On the assumption made there is not as much difference in the total costs of the two road surfaces as would appear from the first costs. It is not known that \$600 per mile per year will absolutely maintain a bituminous-macadam road nor that \$300 per mile per year will strictly maintain a brick road, and the relative value of the two road surfaces at the end of the 20-year term is still to be determined.

The above analysis indicates a method of estimating the total cost of roads and of required bond issues. The total cost of a 15-foot concrete road, for example, may be compared with the above total costs, assuming a construction cost of about \$1.35 per square yard or \$11,880 a mile and an equivalent annual repair and maintenance charge between that of brick and bituminous-macadam.

EXPEDIENCY OF ISSUING HIGHWAY BONDS.

Legal restrictions on bond issues.—Nearly all States restrict the total amount of municipal bonds which may be issued to a fixed percentage of the assessed valuation. In other cases there are legal restrictions governing the amount of taxes which may be raised for highway purposes. These are examples of legal restrictions which must be clearly understood before the issue is made. The question frequently arises regarding the authority of the districts of a county to issue bonds. In a number of States the law allows the creation of highway districts or the issuance of bonds by the legal subdivisions of a county. Care must be exercised to determine to what officers the authority for such issues belongs. Instances have arisen where district road boards have undertaken the issue of bonds legally voted, but where the law provided that the county authorities and not the district authorities must issue the bonds.

¹ See Bulletin No. 48 of the Office of Public Roads, p. 8.

² Use Table 11, p. 18.

In nearly all States county bonds or district bonds of any kind must be authorized by a majority, or a two-thirds vote, of either the entire county or of the district.

Advantage of bond issues.—The issuance of highway bonds is essentially a method of capitalizing the resources of a community for the purpose of creating improved highways. The fundamental advantage of the bond plan is the construction of a good system of roads at once, but there are secondary advantages in building roads in long stretches and in the planning of the maintenance of such roads.

The question is not merely whether a community shall incur a debt; it is also a question as to whether the maximum economic efficiency and the full development of the public wealth will be best promoted by using public credit.

There is shown in Plate III, figure 2 the relation between the volume of traffic in ton-miles, reduction in hauling cost in cents per ton-mile, and the annual cost per \$1,000 of a 20-year bond under the annuity plan. A mile of road sustaining 3,000 tons of travel per year, for example, would pay interest and retirement on \$1,000 in 4 per cent bonds if the cost of hauling were reduced about 2.4 cents per ton-mile.

Emphasis has been placed in this publication on the strictly measurable economic benefits to a community from road improvement. There are many additional economic benefits and very great social benefits which are not readily measured. Increased school and church attendance is shown in repeated instances to be an immediate consequence of better roads.¹ The general stimulus to business is difficult to evaluate. It is evident, however, that business and professional men of all classes are among the first to be benefited. This is especially true of physicians. The cost of upkeep of automobiles, particularly of tires, is becoming yearly a large item and the road condition is a most serious factor for the automobilist and the users of motor trucks.

It should be understood at the outset that the question of debt itself is relatively less important than the question of sound planning and good management of the loan. The very presence of the improved road system increases the value of the county property and therefore the resources supporting the loan. It is a well-established business principle that extension of credit within safe limits is necessary for maximum results. The financing of all private enterprises by bond issues has increased very greatly. In 1908 statistics show that, during the preceding decade, bonds were issued as a method of capitalizing public and private enterprises at the rate of \$583,000,000 annually.

¹ Cf. Farmers' Bulletin No. 505, "The Benefits of Improved Roads." This bulletin may be obtained from the Secretary of the U. S. Department of Agriculture.

Failure of bond issues.—Instances are not lacking where bond issues for highway purposes have proved failures. These instances are invariably due to mismanagement rather than to defective principle. Where counties have issued highway bonds the proceeds of which have been spent to construct temporary road surfaces on unimproved grades and without proper drainage, failure has necessarily resulted. There are on record in the Office of Public Roads instances where so-called macadam roads have been built with bond money by simply dumping broken stone at the wrong time of the year on muddy road surfaces without grades or alignments and without rolling or binding. (Cf. Pl. I, fig. 2.)

A typical method of mismanagement is to distribute the funds equally on all the roads in the county or district issuing the bonds. Recently in a southern State \$40,000 was distributed equally over nearly 90 miles of highway in a certain district. After deducting necessary overhead expenses this sum was equivalent to about \$400 per mile. Obviously no permanent results could be obtained from such a distribution. In another county, where heavy rains and severe winters could not fail to make the roads nearly impassable with the superficial construction adopted, bonds were issued to the amount of \$300,000. The money was devoted to light grading on an excessive mileage without any attempt at surfacing.

Through a misunderstanding of the essential principles underlying the establishment of a proper county road system, conflicts of interest sometimes arise which cause the failure of the bond issue plan. The location of the roads to be improved should not be determined by argument, but upon sound engineering and economic principles. Before a community votes to issue bonds for highways it is necessary to understand thoroughly what roads are to be improved and the approximate cost of their construction and maintenance. Too frequently ill-advised locations are adopted.

Need for highway engineers.—Highway plans for bond issues require expert skill and professional service. Before the amount of bonds is determined, a thorough study of the needs of the county should be made and careful maps of the proposed highway system should be prepared. The sum to be issued should not be fixed until it is reasonably known what it will accomplish. It is customary for many counties to appoint a commission of business men under whose jurisdiction the bond money is expended. In other cases the county supervisor or county commissioner has the direction of expenditures. The best results have always followed where such commissions or county boards have secured the services of a highway engineer.

Guided by the costly experience of many communities, it is now becoming common for counties to adopt this plan. In all engineering construction it is customary to allow a certain percentage of the cost

for engineering and supervision. There is no reason why highway building should be made an exception to this rule. At least 5 per cent of the bond issue may well be set aside for engineering and supervision alone. Money spent to hire a competent engineer¹ to make preliminary investigations before bonds are issued and to plan and supervise construction will be well spent. It is not uncommon to find counties that will repeatedly postpone the sale of bonds in order to obtain an increase of 1 per cent in a bid for \$100,000 or less and then proceed to construct the roads in a most haphazard and ill-planned manner.

Benefit to nonabutting property owners.—In planning the highway system or the main market roads, as mentioned above, it will be found necessary to omit many roads the improvement of which is greatly desired by abutting landowners. The fact that such property holders must pay a tax for the bond issue is only an apparent injustice, for if the highway system is well planned the entire county will feel the benefits of the improvement. As a rule, main market roads reach the majority of producing areas, and when they are improved all land values tend to increase.

The fact that cities and larger towns are frequently taxed for bond issues to build highways outside of their own limits is sometimes made a point of debate in bond elections. It is argued that because a large part of the county wealth is within the corporate limit of such cities and towns, highway bond money should also be used to construct their streets. It is even urged that the expenditure should be made proportionate to the assessed valuation within the city limits. If the proceeds of highway bond issues were distributed in this way their purpose in many cases would be defeated. The primary object of the county highway bond issue is to build county market roads and not to improve city streets, although a high percentage of the assessed valuation may be city property.² It is now known that the expenditure of city taxes on country roads is a sound principle and that it is one of the best features of State aid for highways. In Massachusetts the city of Boston pays possibly 40 per cent of the total State highway fund, but not a mile of State-aid highway has been built within its limits. New York City also pays about 60 per cent of the cost of the State highway bonds. Some State laws prohibit the expenditure of proceeds of State highway bonds within corporate limits of cities or towns. The improvement of market roads results in improved marketing conditions which benefit the city. Most cities are essentially dependent upon the surrounding country for their prosperity and development. The development of suburban property for resi-

¹In the general bond act of September, 1913, by the State of Tennessee the employment of an engineer by the county commissioner is made mandatory. In Virginia the law provides that counties building roads under a bond issue shall employ an engineer either appointed or approved by the State highway commissioner.

²For arguments concerning the benefits of good roads cf. Farmers' Bulletin No. 505.

dence purposes is also dependent upon highway conditions and it is becoming evident yearly that whatever makes for an increase in rural population must be encouraged. Since the introduction of motor traffic, country highways have been used to an increasing extent by city residents. In fact, the cost of maintaining many country highways has been greatly increased by the presence of city-owned motor vehicles. The general advance in facilities for doing country business from town headquarters when roads are improved is no inconsiderable factor in the commercial life of the community.

Examples of county bond-built roads.—The Office of Public Roads during the past four years has undertaken a detailed study of economic conditions in several counties which have issued bonds for highway construction. These studies have involved field work each year for from three to five years in the several counties. The detailed results of these studies are embodied in reports which are now on file in the office. Sufficient data have been gathered to emphasize and illustrate many points brought out by the discussion in the present bulletin.

The locations of the studies were Dinwiddie, Lee, Spotsylvania, and Wise Counties, Va.; Dallas County, Ala.; Lauderdale County, Miss.; Manatee County, Fla.; and Franklin County, N. Y. Although no special field studies were made in Wayne County, Mich., statistics for that county have also been compiled.

TABLE 18.—*Financial items.*

County and State.	Highway bonds.	Term in years.	Nominal interest.	Valuation year of issue.	Percent of valuation in highway bonds.
Dinwiddie, Va.....	\$105,000	20 and 30	5 and 6	\$3,661,897	2.84
Lee, Va.....	440,000	Serial.	5 and 5½	3,014,405	14.59
Spotsylvania, Va.....	183,000	30	5	¹ 1,962,956	9.32
Wise, Va.....	960,000	30	5	11,011,780	8.71
Manatee, Fla.....	250,000	30	5	2,450,000	10.20
Dallas, Ala.....	410,000	30	5	13,330,355	3.08
Lauderdale, Miss.....	350,000	30	5 and 5½	16,443,301	2.13
Franklin, N. Y.....	500,000	60	4½ and 5	12,293,434	4.07
Wayne, Mich.....	2,000,000	Serial.	4	467,400,635	.43

¹ 1913.

The total amount of bonds issued by these counties during the years 1900 to 1913, inclusive, was \$5,188,000, and with the exception of Lee and Wayne Counties, where the bonds were issued under the serial plan, and Franklin County, N. Y., where they are to run for 60 years, they are straight terminable bonds for 30 years. Table 18 summarizes the financial items for each county.

In some instances no preparation has been made for establishing a sinking fund to retire bonds at maturity. In several of these counties there is no provision whatever for systematic maintenance. In Virginia the State law provides that State aid allotted to counties may be used for the redemption of bond issues where the roads are built

in accordance with the requirements of the State highway commissioner and under the supervision of his engineers. In four counties in Virginia the roads are built under this plan. In Dallas County, Ala., the construction of bond-built roads was in charge of the four district commissioners and the probate judge. In Manatee County, Fla., the roads were built under the supervision of the five district county commissioners. In Lauderdale County, Miss., the county supervisors appointed a road commission of three members to construct the roads under the bond issue, and a highway engineer was employed and all work done by contract. In Franklin County, N. Y., the roads were constructed by the county road commissioners and the county superintendent of roads. In Wayne County, Mich., the roads were built by the board of county road commissioners, appointed by the county board of supervisors.

The following table shows the mileage and cost of roads constructed in each county:

TABLE 19.—*Mileage and cost of roads in nine counties where bonds were issued.*

County and State.	Miles built.	Per cent of total mileage in county.	Kind.	Average cost per mile.
Dallas, Ala.....	197	19.0	Gravel.....	\$3,700
Manatee, Fla.....	64	12.8	Sand-clay.....	1,650
Lauderdale, Miss.....	84	10.5	Macadam.....	4,250
Spotsylvania, Va.....	41	10.0	Shell.....	2,400
Dinwiddie, Va.....	125	25.0	Macadam ¹	6,500
Franklin, N. Y.....	124	9.0	Sand-clay.....	1,900
Lee, Va.....	84	18.2	Gravel and sand-clay.....	2,200
Wise, Va.....	131	43.7	Gravel and top soil.....	1,689
Wayne, Mich.....	83.5	5.8	Gravel.....	2,200
			Macadam.....	3,250
			do.....	7,400
			Earth graded.....	5,000
			Macadam.....	8,000
			Earth graded.....	5,300
			Concrete ²	13,200

¹ Surface treated with petroleum asphalt.

² Eighty miles.

In no one of these counties, with the exception of Detroit, in Wayne County, Mich., were there any large cities. The roads were, for the most part, constructed as market roads radiating from the main market towns in the county, as may be seen from the maps of Plates IV, VI, and IX. The economic benefits accruing to the several counties from the improvement of the roads are already apparent, and in several instances have been extraordinary. (Cf. Pls. V, VII, and VIII.)

In Dallas County, Ala., and Lauderdale County, Miss., cotton is the principal crop, although in the latter county lumber is also an important commodity. Lumber and ties form, also, the principal commodity hauled in Spotsylvania County, Va. In Dinwiddie County the principal commodities are tobacco, peanuts, and hay; in Lee County farm and dairy products, hardwood, lumber, and coal; and in Franklin County, N. Y., milk and miscellaneous farm products.

In Manatee County, Fla., the principal crops are citrous fruits and early vegetables, which are shipped north. In Wayne County, Mich., the city of Detroit is the center of the road system and attracts a very large volume of miscellaneous traffic. The estimated annual tonnage hauled over the bond-built highways in almost every instance is sufficiently large to produce, by an assumed reduction of a few cents per ton-mile in cost, a sufficient operating income to cancel the annual interest and retirement fund required by the bonds. The relation of these items is summarized in the following table:

TABLE 20.—*Summary of relation between bond requirements and reduced cost of hauling.*

County and State.	Total annual ton-miles estimated at minimum.	Approximate cost of annual interest and redemption on highway bonds.	Equivalent necessary reduction (cents per ton-mile).
Dallas, Ala.....	600,000	\$28,333	4.7
Manatee, Fla.....	¹ 200,000	17,342	8.7
Lauderdale, Miss.....	720,000	24,530	3.4
Spotsylvania, Va.....	574,720	12,695	2.2
Dinwiddie, Va.....	212,500	8,633	4.1
Franklin, N. Y.....	201,544	25,544	12.6
Wayne, Mich.....	4,353,966	² 179,882	4.1

¹ Rough estimate.

² Equivalent for annuity bond.

The increases in the value of land adjacent to the improved roads are especially noteworthy. In Manatee County, Fla., land increased in value \$20 per acre from 1911 to 1912, and a mile away from the road the increase was \$10 per acre. In Spotsylvania County, Va., land which formerly sold at an average of \$24.74 per acre changed hands within three years at an average of \$44.74. In Dinwiddie County, land between 5 and 10 miles from Petersburg advanced on an average from \$15.25 to \$30 in about 15 instances, and land 10 miles from town increased, on an average in 16 instances, \$16.32 an acre. On eight pieces of land in Franklin County, selected at random, there was an increase in value of 27.8 per cent after the improved roads were built, and in Lee County, Va., land advanced 25 per cent.

The construction of the bond-built highways in several of the counties herein mentioned has been of decided benefit to school attendance. In Spotsylvania County one consolidated school replaces three one-room schools, and another consolidated school is planned. In Dinwiddie County school attendance increased 17½ per cent in one year on the improved roads, and several school wagons carrying 24 pupils each have been put in service. In Lee County school attendance along the improved roads shows an average of 71 per cent against 62 per cent along other roads. In Wise County several successful school consolidations have been effected since 1909. The Pole Bridge School in this county on the road from Coburn to Wise replaces four one-room schools.

APPENDIX A.

STATE HIGHWAY BONDS.

TABLE 21.—Complete list of State highway bonds.

State.	Year.	Amount (by years).		Rate (per cent).	Term (years).	How redeemed.
		Voted.	Issued.			
California.....	1910	\$18,000,000	.....	4	50	\$400,000 annually after July 1, 1917.
	1912	.....	\$2,000,000	4	50	
	1913	.....	3,390,000	4	50	
	Total.....	18,000,000	5,390,000	.....	.....
Connecticut.....	1907	² 4,500,000	1,500,000	3½	22	\$205,000 annually.
	1909	.....	1,500,000	.....	.....
	1911	³ 3,000,000	2,000,000	4	25	\$120,000 annually.
	1913	³ 3,000,000	2,000,000	4	25	
	Total.....	10,500,000	⁴ 7,000,000	.....	.....	Do.
Idaho ⁶	1905	50,000	50,000	4	30	Sinking fund.
	1907	18,000	18,000	4	20	Do.
	1909	22,000	22,000	4	10 and 20	Do.
	1911	136,000	136,000	4, 4½, 5	5, 6, 10, 20	Do.
	1912	29,000	29,000	4½ and 5	20	Do.
	1913	250,000	250,000	4	20	Do.
	Total.....	505,000	505,000	.....	.....	.....
Maine ⁶	1912	2,000,000	.....	.....	.....	\$7,500 annually.
	1913	.....	300,000	4	40	
	Total.....	2,000,000	300,000	.....	.....
Maryland ⁷	1908	5,000,000	500,000	3½	15	Sinking fund.
	1909	.....	1,000,000	3½	15	Do.
	1910	⁸ 1,000,000	1,000,000	3½ and 4	15	Do.
	1911	.....	1,250,000	3½ and 4	15	Do.
	1912	⁹ 3,170,000	2,250,000	(⁹)	.....	Do.
	1913	.....	2,646,000	.....	.....	.....
	Total.....	9,170,000	8,646,000	.....	.....	.....
Massachusetts.....	1894	300,000	300,000	3½	26	Do.
	1895	400,000	400,000	3½	25	Do.
	1896	600,000	600,000	3½	24	Do.
	1897	800,000	700,000	3½	30	Do.
	1898	400,000	300,000	3	30	Do.
	1899	500,000	400,000	3	30	Do.
	1900	500,000	400,000	3	30	Do.
	1901	500,000	350,000	3	30	Do.
	1902	500,000	375,000	3 and 3½	30	Do.
	1903	2,250,000	400,000	3½	30	Do.
	1904	.....	300,000	3½	28	Do.
	1905	.....	250,000	3½	25	\$10,000 annually.
	1906	.....	300,000	3½	30	Do.

¹ *California*.—Proceeds of bond issue to be expended on a continuous and connected State highway system running north and south through the State, traversing the Sacramento and San Joaquin Valleys and along the Pacific coast, by the most direct and practicable routes, connecting the county seats of the several counties through which it passes, together with such branch roads as may be necessary to connect therewith the several county seats lying east and west of such State highway. No limitation on annual expenditure.

² *Connecticut*.—To be expended during the six fiscal years ending Sept. 30, 1913. Bonds to be paid in 22 annual installments by appropriation from general fund.

³ \$1,000,000 for improvement of public roads; \$2,000,000 for improvement of trunk-line roads. The 1911 and 1913 bond issues mature in 1936, but may be redeemed by the State treasurer whenever and in such manner as he deems to be for the best interest of the State. They are not specifically known as road bonds; but the 1911 highway appropriation was specifically designated by the legislature to be from the proceeds of the \$6,000,000 State issue of bonds. The 1913 appropriation is made from the treasury, while the treasurer is, in a special act, authorized and instructed to issue \$4,000,000 additional bonds to meet the needs of the State.

⁴ For trunk-line roads only.

⁵ *Idaho*.—For various roads and bridges specified in the act authorizing each bond issue, except \$200,000 in 1913, which is expended under State highway commission.

⁶ *Maine*.—Not to exceed \$2,000,000 shall be outstanding at any one time. To be expended in the construction of State highways, the whole cost to be paid by State, except where a town may desire the joint State-aid fund to be applied on State highway.

⁷ *Maryland*.—For State roads.

⁸ Not to exceed \$250,000 to be issued in any one year, beginning Jan. 1, 1911.

⁹ To be issued in amounts of not less than \$500,000 at a time upon request of the State roads commission. Rate of interest to be fixed by the governor, the comptroller of the treasury, and the State treasurer.

TABLE 21.—Complete list of State highway bonds—Continued.

State.	Year.	Amount (by years).		Rate (per cent).	Term (years).	How redeemed.
		Voted.	Issued.			
Massachusetts	1907	\$2,500,000	\$360,000	3½	30	\$12,000 annually.
	1908	-----	495,000	3½	30	\$16,500 annually.
	1909	-----	380,000	3 and 3½	10-30	\$220,000 deferred serial, 1920-1939.
	1910	-----	285,000	3½	10-30	\$180,000 deferred serial, 1920-1939.
	1911	-----	310,000	3½	10-30	\$200,000 deferred serial, 1921-1940.
	1912	5,000,000	435,000	3½	10-30	All but \$175,000 deferred serial.
	1913	¹ 115,000	1,110,000	3½	-----	Serial.
Total.....		14,365,000	8,450,000	-----	-----	-----
New Hampshire	1909	² 1,000,000	-----	-----	-----	-----
	1910	-----	250,000	3 and 3½	-----	Deferred serial, 1914-1917.
	1911	-----	250,000	3½	-----	Deferred serial, 1917-1921.
	1912	-----	250,000	3½	-----	Deferred serial, 1921-1924.
	1913	³ 300,000	⁴ 250,000	3½	-----	-----
Total.....		1,300,000	1,000,000	-----	-----	-----
New Mexico ⁵	1912	500,000	-----	4	-----	-----
Total.....		500,000	(⁶)	-----	-----	-----
New York	1906	⁷ 50,000,000	-----	-----	-----	Sinking fund.
	1907	-----	1,000,000	3	50	Do.
	1908	-----	5,000,000	4	50	Do.
	1909	-----	5,000,000	4	50	Do.
	1910	-----	5,000,000	4	50	Do.
	1911	-----	10,000,000	4	50	Do.
	1912	⁸ 50,000,000	8,000,000	4	50	Do.
	1913	-----	16,000,000	4½	50	Dated Sept. 1, 1913; sold Jan. 14, 1914.
		-----	5,000,000	4½	50	
Total.....		100,000,000	55,000,000	-----	-----	-----
Rhode Island	1906	⁹ 600,000	-----	3	30	Sinking fund.
	1909	600,000	-----	3½	30	Do.
	1912	¹⁰ 600,000	-----	4	30	Do.
Total.....		1,800,000	1,800,000	-----	-----	-----
Utah.....	1911	¹¹ 260,000	-----	4	23	Deferred serial, 1922-1934.
	Total.....	260,000	260,000	-----	-----	-----
Washington ¹²	1911	190,000	125,000	4	12	Paid from State highway fund.
	Total.....	190,000	125,000	-----	-----	-----
Totals.....		158,590,000	88,476,000	-----	-----	-----

¹ Massachusetts.—Authorized for special State roads by legislature, 1913.

² New Hampshire.—Not to exceed \$250,000 to be issued in any one year, and the proceeds to be used exclusively for State aid in the construction of the three trunk lines to be designated by the governor and council from the Massachusetts State line in a northerly direction.

³ To be used for State aid in constructing trunk-line highway to be designated by the governor and council.

⁴ Not sold Dec. 1, 1913.

⁵ New Mexico.—These bonds shall be in denominations of \$1,000, numbered 1 to 500, the first 20 of which shall be payable on Jan. 1, 1919, and 20 of said bonds, in consecutive numerical order, shall be due and payable on July 1 annually thereafter until and including July 1, 1942. The proceeds are to be expended for the construction and maintenance of a system of State highways.

⁶ Bonds not sold Dec. 31, 1913.

⁷ New York.—These bonds were to be issued in two classes, to be known as A and B. Class A is coupon or registered, and redeemable from a State sinking fund, while Class B bonds were to be registered and redeemable from a redemption fund provided by the counties and towns wherein the proceeds thereof should be applied to the improvement of highways.

⁸ The act of the legislature authorizing this issue of bonds was ratified and rendered operative by vote of the people at the general election, November, 1912. Of the proceeds, \$20,000,000 shall be devoted to State highways, to be built at sole cost of the State, and \$30,000,000 to county highways, to be built at joint expense of State and county.

⁹ Rhode Island.—\$200,000 to be issued before Jan. 1, 1907, and the balance on or before Jan. 1, 1908; the proceeds to be used in building a system of State roads under the direction of the State board of public roads.

¹⁰ To be used for construction, reconstruction, and maintenance.

¹¹ Utah.—The proceeds to be divided equally among the counties of the State, exclusive of Salt Lake County, to be used in the construction and maintenance of State roads and bridges therein. Bonds dated July 1, 1911.

¹² Washington.—For purchase of bridge across the Columbia River at Wenatchee.

STATE BOND ISSUES DEFEATED.

Colorado.—The proposition to issue \$10,000,000 in State bonds for roads was submitted to the people of Colorado at the general election in November, 1912, and was defeated. The proposition can not be again submitted to the people within a few years.

Ohio.—At the general election in November, 1912, there was submitted to a vote of the people of Ohio a proposition to issue \$50,000,000 in State bonds to construct a system of intercounty highways. The vote on this proposition numbered about three-quarters of a million, and the bond issue was defeated by 2,017. One remarkable fact in connection with this vote was that the cities of the State gave substantial majorities for the bond issue, while the rural vote was substantially against it, and to such an extent as to overcome the city majority, although about 80 per cent of the taxes which would have been levied to take care of the interest and sinking fund of the bonds would have been paid by the cities.

Rhode Island.—On June 3, 1913, a special election was held in the State of Rhode Island on the issuance of \$700,000 of State bonds for the purpose of completing a system of State roads. At this election only about 14 per cent of the voters of the State attended the polls, and the proposition was overwhelmingly defeated.

Pennsylvania.—On November 3, 1913, at a general election a proposed issue of \$50,000,000 in highway bonds was defeated, although the proposition carried in Philadelphia and Pittsburgh.

APPENDIX B.

APPROXIMATE LISTS OF COUNTY AND DISTRICT HIGHWAY AND BRIDGE BONDS; TOWNSHIP HIGHWAY AND BRIDGE BONDS; COUNTY, DISTRICT, AND TOWNSHIP HIGHWAY AND BRIDGE BONDS VOTED IN 1912 AND 1913; COUNTIES, DISTRICTS, BEATS, AND TOWNSHIPS GIVING COMPLETE MILEAGE RETURNS OF ROADS BUILT UNDER BOND ISSUES; TOWNSHIPS AND TOWNS GIVING COMPLETE MILEAGE RETURNS OF ROADS BUILT UNDER BOND ISSUES; SUMMARY OF ALL HIGHWAY AND BRIDGE BONDS VOTED TO JANUARY 1, 1914.

TABLE 22.—*County and district highway and bridge bonds.*¹

ALABAMA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total Amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Autauga.....	\$65,000	30	5	Limestone.....	\$135,000	30	4½
Blount.....	150,000	30	5	Madison.....	172,500	.....	5
Bullock.....	160,000	30	5	Marion.....	100,000	20	5
Butler.....	155,000	.....	.....	Marshall.....	130,000	30	5
Colbert.....	200,000	30-35	5	Mobile.....	500,000	20	5
Conecuh.....	200,000	.....	.....	Montgomery.....	850,000	.....	4½-5
Crenshaw.....	125,000	.....	.....	Morgan.....	240,000	30	5
Dallas ²	410,000	30	5	Perry.....	126,000	30	5
Elmore.....	170,000	30	5	Pike.....	192,000	.....	4½
Escambia ³	38,000	.....	5½	Russell.....	100,000	30	5
Hale.....	100,000	.....	.....	St. Clair.....	85,000	30	5
Jackson.....	250,000	.....	.....	Sumter.....	120,000	20	5
Jefferson.....	200,000	30	6-5-6				
Lawrence.....	123,000	30	6	Total.....	5,121,500	.....	.....
Lee.....	25,000	30	4½				

ARIZONA.

Apache.....	\$30,000	.....	5	Maricopa—Con.			
Greenlee: Duncan ⁴ ..	16,000	.....	6	Special road district 2.....	\$40,000	20	6
Maricopa:				Mohave.....	100,000	.....	5
Phoenix (city) ⁵	60,000	20	5	Yuma.....	500,000	.....	.....
Mesa (city) ⁵	2,000	20	5				
Special road district 1.....	30,000	(⁶)	6	Total.....	808,000	.....	.....
Special road district 1.....	30,000	20	6				

ARKANSAS.

Benton.....	\$2,815	12	.....	Montgomery.....	\$10,000	.....	.....
Crawford ³	174,000	.....	.....	Sebastian: Ft. Smith ³	600,000	.....	.....
Jefferson.....	45,500	13	6	Woodruff: District 1.....	30,000	20	6
Lee.....	151,000	.....	.....		
Lonoke.....	205,000	20	5	Total.....	1,218,315	.....	.....

¹ In 21 States highway and bridge bonds have also been issued by townships. See list following.

² Includes \$60,000 of bridge bonds.

³ Bridge bonds only.

⁴ Bridge.

⁵ To cover partial cost of improvement of Phoenix to Roosevelt Dam road.

⁶ Serial.

TABLE 22.—County and district highway and bridge bonds—Continued.

CALIFORNIA.

Counties.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Alpine ¹	\$4,800		5	Riverside.....	\$1,500,000		
Contra Costa.....	300,000			Sacramento ³	825,000	2-40	4½
Fresno ¹	80,000		6	San Diego.....	1,250,000	40	4½
Glenn.....	450,000	(²)	5	San Joaquin.....	1,850,000	40	5
Humboldt.....	15,000	20	7-9	San Mateo.....	1,298,000	7-10-40	5
Kern.....	2,500,000	25	5	Santa Barbara.....	290,000	20	6
Lake.....	20,000		5	Tehama.....	3,000		6
Los Angeles.....	3,500,000	40	4½	Ventura ¹	275,000		5
Orange.....	1,370,000		5				
Plumas.....	100,000	10-25	4	Total.....	15,630,800		

COLORADO.

Counties.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>
Delta.....	\$71,700		5
Garfield.....	28,000		6
San Miguel.....	35,000		6
Total.....	134,700		

DELAWARE.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Kent.....	\$30,000	20	5	Districts 1-10.....	\$50,000	5-11	4
New Castle.....	1,285,000	20-51	4-4½-5				
Sussex ¹	30,000	5-24	4½	Total.....	1,395,000		

FLORIDA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Alachua.....	\$40,000			Nassau.....	\$180,000		
Bradford: Hampton..	25,000	20	6	Orange.....	800,000	30	5
Clay.....	150,000			Palm Beach.....	345,000	30	4½
Columbia.....	40,000		6	Pasco.....	150,000	30	5
Dade.....	250,000	20	5	Pinellas.....	370,000	30	5
De Soto.....	250,000			Polk: Winterhaven..	130,000		
Duval.....	1,050,000	25	5	Putnam.....	155,000		5
Franklin.....	20,000	20	4½	St. John.....	70,000		
Hernando.....	300,000	30	5	St. Lucie.....	200,000		
Hillsborough.....	1,400,000	30	5	Seminole.....	200,000		
Holmes: 1 district..	40,000	30	6	Walton.....	70,000	20	6
Jackson.....	300,000	30	4				
Lake.....	500,000	2-15-30	5	Total.....	7,285,000		
Manatee.....	250,000	30	5				

GEORGIA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Ben Hill.....	\$75,000		5	Miller.....	\$48,000		
Bleckley.....	8,000			Spalding.....	10,000		
Clarke.....	100,000		4	Towns.....	4,000		
Colquitt.....	400,000			Troup.....	200,000		
Gordon.....	8,000			Turner.....	20,000		5
Hancock.....	51,000	30	5				
Laurens.....	202,000		5	Total.....	1,176,000		
Marion.....	50,000						

¹ Bridge bonds only.² Serial.³ Bridge bonds, \$225,000.⁴ Of this amount \$275,000 was for bridges.

TABLE 22.—County and district highway and bridge bonds—Continued.

IDAHO.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Ada.....	\$234,484	10-20	4½-5	Kootenai.....	\$83,071		
Bear Lake.....	45,000	4	5½	Lincoln.....	130,000	10-20	6
Boise.....	70,000	20		Oneida: Districts 1-3.....	59,000		5
Canyon.....	¹ 198,782	10-20	4-5	Twin Falls.....	³ 100,000	10-20	3½
Custer ²	15,000		6	Washington ²	6,500		6
Fremont: District 1.....	120,000	10-20	6				
Gooding.....	160,000			Total.....	1,221,837		

ILLINOIS.

Edwards: District 3.....	\$3,000	2	6	Wabash.....	\$12,000	⁵ 5	5
Jackson ⁴	36,320	1-20	4½				
Peoria ⁴	320,000			Total.....	420,320		
St. Clair: Centerville District.....	49,000	⁵ 20	5				

INDIANA.

Adams.....	\$151,550	10	4½	Marshall.....	\$86,400	15	4½
Allen.....	53,840	10	4½	Martin.....	189,881		4½
Bartholomew.....	365,572	10	4½-5	Miami.....	636,656	10-20	4½
Boone.....	223,260	10	4½	Monroe.....	315,000		
Carroll ⁶	80,000		4-6	Montgomery.....	1,795,723		
Cass.....	569,258			Morgan.....	341,200	10	4½
Districts 1-3.....	112,425	10	4½	Newton.....	67,021		
Clark.....	51,250			Ohio.....	74,000	10	5
Clay.....	73,800	10	4½	Owen.....	199,693	20	4½
Crawford.....	46,000		4½	Parke.....	390,996		
Daviess.....	90,000	10	4½	Porter: Districts 1-3.....	1,055,880	10-20	4½-5
Dearborn.....	232,272	1-20	4½	Posey: Districts 1-3.....	648,244		4½-6
Decatur.....	⁷ 63,880	10-15	4½	Putnam.....	54,300		
Delaware.....	100,000	10-20	4½	Districts 1-3.....	58,689	10	4½
Dubois.....	196,949			Randolph.....	27,150		5
Fayette.....	53,610	10	4½	Ripley.....	800,000		4½
Fountain.....	137,950	10	4½	Rush.....	489,000	10-20	4½-5
Franklin.....	111,000		3½-5	St. Joseph ⁶	523,200	10	4½
Fulton ⁶	50,000	20	4½	Shelby ⁶	144,455	20	4½-6
Gibson.....	77,300	10	4½	Spencer.....	105,000		3½
Greene.....	42,499	10	4½	Starke.....	41,000	10	4½
Hancock.....	⁸ 273,500	1-10	4½-5	Sullivan.....	80,982	10	4½
Harrison.....	43,220	20	4½	Switzerland.....	55,672		
Henry.....	41,269			Tippecanoe ⁶	260,000	10	4½
Huntington.....	341,932	10	4½	Tipton: Districts 1-3.....	673,140	10	4½
Jackson.....	⁹ 29,640	10	4½	Union.....	60,000		
Jasper.....	127,500			Vanderburg.....	256,196	10	4½
Jay.....	50,370	10	4½	Vermilion.....	462,800		4-4½
Jefferson.....	113,525	20	4½	Vigo.....	305,000		4½
Jennings.....	69,300	10	4½-5	Wabash.....	145,320	10	4½
Knox.....	189,360	10	4½	Wayne.....	88,200	10	4½
Kosciusko.....	1,440			Wells.....	¹¹ 477,791		
Laporte.....	949,640	20	4½	White.....	513,000	10	4½
Lawrence.....	93,000	10		Whitley.....	8,369		
Madison.....	45,000		4½				
Marion.....	¹⁰ 1,378,000	10-20	3½-4½-5	Total.....	18,072,049		

¹ Bridge bonds \$151,162.² Bridge bonds.³ \$50,000 for bridges.⁴ Bridge.⁵ Serial.⁶ Bridge bonds only.⁷ Bridge bonds \$30,000.⁸ Bridge bonds \$25,000.⁹ Bridge bonds \$15,000.¹⁰ Bridge bonds \$200,000.¹¹ Outstanding.

TABLE 22.—County and district highway and bridge bonds—Continued.

IOWA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Adams.....	² \$102,298			Iowa ¹	\$50,000		
Allamakee ¹	24,000			Jackson ¹	137,000	20	4-5
Audubon ¹	42,000			Kossuth ¹	⁷ 137,738	6-14	4½
Blackhawk.....	³ 14,226			Lee ¹	50,000		
Boone.....	60,450	12	4½	Lucas.....	31,600		4½
Buchanan.....	³ 15,087			Madison ¹	45,000	3-17	4½-5
Buena Vista.....	³ 16,797			Mahaska.....	117,000		4½
Calhoun ¹	40,000			Marion ¹	107,000	10-20	4-4½
Carroll.....	40,000		4	Mills.....	27,000		
Cass ¹	⁴ 162,066		4-4½	Palo Alto.....	4,000		
Cedar ¹	23,000			Plymouth.....	20,000		5
Cherokee.....	25,000			Polk.....	¹ 219,900		3½-5
Clarke.....	19,000			Pottawattamie.....	² 37,290		
Clinton ¹	57,000		4½	Sac ¹	25,000		
Crawford.....	50,000			Shelby ¹	23,092		
Dallas.....	67,000			Union.....	96,000		4-4½-5
Davis ¹	47,500		4½	Van Buren.....	109,000		4½
Decatur.....	19,000		4½	Wapello ¹	91,000		
Delaware.....	³ 3,126			Warren ¹	163,000	20	4
Des Moines.....	79,000			Winneschiek.....	⁸ 160,000		
Dickinson ¹	10,000			Woodbury ¹	⁹ 63,748		
Dubuque.....	³ 37,599			Wright.....	¹⁰ 149,452	9-15	4½-5
Fayette ¹	⁵ 35,352		4½				
Floyd.....	³ 4,187			Total.....	¹¹ 4,006,314		
Freemont ¹	⁶ 137,806	20	4½-5				

KANSAS.

Bourbon.....	\$2,700			Marion.....	\$6,000	5-9-11	6
Cloud.....	13,675			Pawnee ¹	8,000		4½-5
Douglas.....	66,500		4½	Reno.....	12,800		6
Edwards ¹	20,000			Sedgwick.....	101,550	10	5
Geary.....	86,150		4	Wyandotte.....	¹² 695,000	20-30	4½
Gray.....	5,000		6				
Hamilton ¹	31,000	25	4	Total.....	1,132,375		
Johnson.....	84,000		5				

KENTUCKY.

Bath.....	\$38,000			Madison.....	\$70,000		
Boyle.....	4,000		4	Mason.....	60,000		
Bullitt.....	50,000		5	Montgomery.....	29,000		
Carroll.....	40,672		4-5-6	Nicholas: Districts			
Christian.....	202,000			1-4.....	40,000	25	4
Clark.....	60,000			Ohio.....	30,000		4
Franklin.....	23,000			Owen.....	170,000		5
Gallatin.....	38,500		4-6	Pendleton.....	175,000		4½-5-6
Garrard.....	33,000		4	Robertson.....	10,400	5-8	5
Grant.....	90,000		4½-6	Scott.....	196,000		4-5
Harrison.....	37,500			Trimble.....	120,000		
Kenton.....	197,100			Woodford.....	17,500		
Lewis.....	6,200						
Lincoln.....	22,000			Total.....	1,759,872		

¹ Bridge bonds only.² Includes \$16,298 outstanding warrants.³ Outstanding bridge warrants.⁴ Includes \$4,060 outstanding bridge warrants.⁵ Includes \$5,352 outstanding bridge warrants.⁶ Includes \$8,806 outstanding bridge warrants.⁷ Includes \$60,738 outstanding bridge warrants.⁸ Includes \$65,000 outstanding bridge warrants.⁹ Includes \$20,748 outstanding bridge warrants.¹⁰ Includes \$54,452 outstanding bridge warrants.¹¹ County officials may issue bonds to pay accumulated outstanding warrants and the above list for the most part represents such funded warrants, all for bridges. It is customary to pay, in most instances, interest at 4, 4½, and 5 per cent.¹² Bridge bonds \$100,000.

TABLE 22.—County and district highway and bridge bonds—Continued.

LOUISIANA.

Parishes ¹ and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Parishes and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Assumption.....	\$86,000	10	5	Jefferson.....	\$200,000		
Bossier.....	175,000	1-40	5	Lafayette.....	75,000	25	5
Calcasieu.....	900,000	25	5	Plaquemines.....	60,000		
De Soto.....	60,000	10	5	Tangipahoa: District			
East Baton Rouge...	22,000	10	5	2.....	75,000	30	5
District 1.....	15,000	20	5	Tensas.....	47,000		
Franklin.....	16,914		5	Washington.....	116,597	2-4	5
Iberia.....	70,000	10	5	Total.....	1,932,840		
Iberville: Districts 1, 5, and 6.....	14,329	1-10	5				

MARYLAND.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Allegany.....	\$10,000	2½	5	Kent ²	\$10,000		5
Anne Arundel.....	37,000		5	Montgomery.....	144,500	25	4½
Calvert ²	3,000		5	Prince Georges.....	16,000	30	5
Caroline.....	50,000	20	5	Queen Annes.....	63,000		
Cecil.....	100,000		5	Talbot ²	37,000		
Charles.....	10,000		5	Worcester.....	100,000	25	5
Dorchester.....	43,000		4	Total.....	750,500		
Frederick.....	127,000	15-30	4½				

MASSACHUSETTS.

Barnstable ²	\$14,000			Norfolk ²	\$50,000	(³)	4.92
Berkshire.....	5,000	1-2	4½	Plymouth ²	20,000		4
Bristol.....	7,000	1-3	4½	Total.....	813,000		
Essex.....	661,000		3½-4				
Nantucket.....	56,000	5	4				

MICHIGAN.

Alger.....	\$150,000			Mackinac.....	\$100,000	10-26	5
Alpena.....	100,000	20	5	Manistee ²	32,000		
Baraga.....	40,000		6	Mason.....	100,000		
Bay.....	255,000			Menominee.....	50,000		
Berrien.....	500,000	15	4	Midland.....	56,000	15	5
Delta.....	162,500			Muskegon ²	25,000	15	4½
Emmet.....	225,000			Ontonagon.....	38,000	10	5
Genesee.....	700,000	10-20	4½	Ottawa.....	600,000		
Gogebic.....	150,000	10	4½	Schoolcraft.....	40,000		5
Houghton.....	30,000		6	Wayne.....	2,000,000	15	4
Ingham.....	63,652			Wexford.....	50,000		
Ionia.....	20,000			Total.....	6,382,152		
Iron.....	160,000		5				
Kent.....	735,000	20	4½				

MINNESOTA.

Aitkin ²	\$16,000		6	Lake.....	\$20,000	4	6
Anoka ²	40,000		4	Mahnomen.....	5,000	20	4
Beltrami.....	631,350	20	4	Ramsey ²	75,000	30	4½
Cook.....	60,000			St. Louis.....	300,000		
Crow Wing ²	50,000		6	Winona.....	50,000	5-7	5
Hennepin.....	110,000	30	4½	Total.....	1,388,350		
Itasca ²	31,000	20	5				

¹ Parishes are equivalent to counties.² Bridge bonds only.³ Nine months.

TABLE 22.—County and district highway and bridge bonds—Continued.

MISSISSIPPI.

Counties, beats, ¹ and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties, beats, and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Adams.....	\$150,000			Leflore.....	\$300,000	20	5
Alcorn.....	95,000		5	Lincoln.....	200,000	25	5
Attala.....	50,000	25	5	Lowndes: Beat 2.....	50,000	10-20	5
Benton.....	6,000			Marshall.....	20,000		5
Bolivar.....	392,000		4½-6	Monroe.....	535,000		6
Calhoun: Beat 1.....	125,000	25	6	Montgomery.....	40,000		
Chickasaw: Beat 3.....	220,000	20	5	Neshoba.....	100,000		
Claiborne.....	75,000	20	5	Noxubee.....	380,000		
Clay: Beats 1-3.....	221,000	10-25	5-6	Beats 2, 3, and 5.....	377,500		
Coahoma.....	225,000		4½	Oktibbeha.....	20,000		
Copiah.....	305,000			Panola.....	50,000		6
Beat 2.....	75,000	25	6	Perry.....	80,000		5
Covington.....	50,000	30	5	Pike.....	200,000		
De Soto: Beats 1, 2, 3, and 5.....	250,000		6	Pontotoc.....	25,000	20	
Forrest.....	120,000		5	Prentiss.....	50,000		
Beats 1 and 3.....	100,000	40	5	Beat 1.....	40,000	25	6
Franklin ²	35,000		5	Quitman.....	174,000		4-4½
George.....	30,000			Rankin.....	30,000		5
Greene.....	52,000	1-10	5-6	Brandon.....	10,000		
Grenada.....	³ 75,000	20	4½	Scott.....	75,000		
Hancock.....	⁴ 200,000	5-20	1½-2½-6	Sharkey.....	50,000		5
Hinds.....	300,000	25	5	Simpson.....	40,000	20	5
Beats 1 and 5.....	200,000	25	5	Beats 1 and 2.....	40,000	20	5½
Issaquena.....	⁵ 59,500	40	6	Smith.....	40,000		
Itawamba.....	65,000			Tallahatchie.....	140,000		5-6
Jackson.....	160,000		5	Beats 1 and 5.....	75,000	25	6
Jasper.....	25,000			Tishomingo.....	35,000		6
Jefferson.....	40,000			Tunica.....	50,000		4
Jefferson Davis.....	20,000	20	5	Union.....	50,000		6
Jones.....	20,000			Warren.....	⁶ 369,000	20	5
Beat 2.....	50,000	25	5	Washington.....	100,000	25	5
Lafayette.....	180,000	25	5½-6	Wilkinson ²	31,372	10-20	5
Lamar.....	71,000		5	Yalobusha.....	62,000	25	5
Lauderdale: Beats 1 and 5.....	350,000	30	5-5½	Beats 2 and 4.....	48,000	25	5½-6
Lawrence.....	25,000			Yazoo: Four beats.....	77,500	25	6
Lee.....	250,000						
Beats 1 and 2.....	80,000	25	5½-6	Total.....	8,710,872		

MISSOURI.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Boone ²	\$120,000	2-25	5	Lafayette.....	\$125,000	1-15	5½
Callaway.....	100,000			Lawrence: Mt. Vernon	50,000		
Cedar.....	19,000			Mississippi.....	7,000	19	6
Christian.....	6,000		6	New Madrid:			
Clinton.....	4,000		5	King's Highway.....	93,000		
Clay: Two districts.....	135,000			Malden Risco.....	20,000		
Cooper.....	3,000		6	Newton: Neosho.....	30,000	15	6
Dade.....	77,000		4	Nodaway.....	15,000		
Franklin.....	325,000	10-20	6	Pettis.....	200,000		5
Greene.....	238,000		6	Stone.....	10,000	17	6
Grundy.....	5,000		6	Taney.....	7,500		
Howell.....	30,000			Total.....	1,721,500		
Jefferson.....	30,000						
Laclede.....	72,000		4				

¹ Counties are subdivided into beats.² Bridge bonds only.³ Twelve miles of levee.⁴ Of this amount \$150,000 includes bridges, sewers, and culverts.⁵ Bridge bonds, \$20,000.⁶ Of this amount \$110,400 was issued for building bridges.

TABLE 22.—County and district highway and bridge bonds—Continued.

MONTANA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Blaine.....	\$40,000	20	5	Ravalli.....	\$72,106		
Broadwater.....	102,000			Rosebud.....	³ 328,000		4½-6
Carbon.....	90,000	20	5	Sanders.....	130,000		5
Cascade.....	60,000	20	5	20 districts.....	15,000	5-20	5
29 districts ¹	45,000	20	5	Sweet Grass.....	35,000		4½
Custer.....	320,000	20	4½	Teton.....	100,000		
Dawson.....	100,000		4½	33 districts.....	⁴ 100,000	20	5
Flathead.....	177,500		5	Valley ¹	65,000		
Lewis and Clark.....	105,000	20	4½	Yellowstone ¹	70,000		
Lincoln.....	125,000	20	5				
Meagher.....	30,000			Total.....	2,239,606		
Musselshell.....	² 130,000	20	5				

NEBRASKA.

Blaine.....	\$5,000		6	Lincoln.....	\$15,000		
Dawson ¹	6,000			Morrill ¹	17,000		4½-5
Douglas.....	⁵ 308,000		4½	Nance ¹	82,500		3-7
Garfield ¹	4,000		5	Scotts Bluff.....	37,000		5-6
Keith ¹	49,000		4-6				
Keyapaha ¹	30,000		3½-5	Total.....	553,500		

NEVADA.

Churchill.....	\$23,000	2-11		Washoe ¹	\$97,000		5-6-8
Douglas.....	15,000		4½-5				
Ormsby.....	40,000	20	5	Total.....	175,000		

NEW JERSEY.

Atlantic.....	\$307,000		4-5	Middlesex.....	\$781,500		3½-4½
Bergen.....	2,121,000		4-4½	Morris.....	400,000		4
Burlington.....	55,000	15	4½	Ocean.....	35,000	30	5
Camden.....	348,900		4-4½	Passaic.....	⁶ 941,500	14-17	4-4½-5
Cape May.....	329,300	30	4½	Salem.....	45,000		4
Cumberland.....	43,000		4½	Somerset ¹	75,000		
Essex.....	1,140,505		4	Sussex.....	154,100		4
Gloucester.....	200,000		4-4½	Union.....	615,000		4-4½
Hudson.....	6,098,977	50	4-4½	Warren ¹	30,000	5-10	4
Hunterdon.....	232,000	30	4				
Mercer.....	434,000	30	4-4½	Total.....	14,386,782		

NEW MEXICO.

Bernalillo ⁷	\$100,000	10-30	4½	San Juan ¹	\$18,000	20-30	6
Dona Ana.....	100,000	32	5				
Eddy ¹	28,500	10-20-30	6	Total.....	246,500		

¹ Bridge bonds only.² Of this amount \$29,970 was used for building three bridges; balance for 300 miles of road.³ Of this amount \$113,000 was for bridges.⁴ Of this amount \$30,000 was for bridges.⁵ Including inheritance tax.⁶ Of the \$136,000 voted in 1913, \$26,000 was used for a bridge.⁷ Roads and bridge bonds only.

TABLE 22.—County and district highway and bridge bonds—Continued.

NEW YORK.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Albany.....	\$749,000			Ontario.....	\$176,000		
Cayuga.....	29,777	1-20	4½-5	Orange.....	689,000	30	3½-4½
Chautauqua.....	160,000			Orleans.....	156,000		4½-5
Chemung.....	99,670			Otsego.....	60,000	10-15	4-4½-5½
Clinton.....	15,000		3½-4½	Putnam.....	38,000	15	4½
Columbia.....	56,000		3½-4½	Rensselaer.....	465,000		3
Erie.....	1,297,000		3½-4½	St. Lawrence.....	125,000	6	4
Franklin.....	533,000	60	4½	Saratoga.....	150,000	5-14	5
Fulton.....	70,000		4	Seneca.....	62,217	10	4.7-4½
Greene.....	109,500		3½-4	Steuben.....	60,000		4½
Herkimer.....	408,000		4	Suffolk.....	110,000	13½	4½
Jefferson.....	130,000		4	Tompkins.....	73,000		4
Lewis.....	25,244		5-6	Ulster.....	269,000		4-4½
Livingston.....	77,106	4	4½-4¾	Warren.....	215,000		5
Montgomery.....	201,000		4½	Westchester.....	275,660	20-25	4½
Nassau.....	2,007,749	6-20	{ 4-4½- 4.7-5	Wyoming.....	52,000		4½
Niagara.....	4,000			Total.....	9,097,923		
Oneida.....	150,000		5				

NORTH CAROLINA.

Alamance.....	\$400,000		5	Iredell.....	\$400,000		5
Anson.....	100,000			Jones ¹	10,000		
Beaufort ¹	² 125,000			Lee.....	100,000	40	5
Bertie.....	20,000		5	Lincoln.....	200,000	40	5
Brunswick.....	40,000			McDowell.....	9,273	5-10	6
Buncombe.....	50,000		5-6	Madison.....	300,000		
Cabarrus.....	³ 145,000	30		Mecklenburg.....	300,000		
Cherokee: Marble District.....	187,000			Nash and Edgecombe Rocky Mt. District.....	30,000	30	6
Cleveland.....	60,000	40	6	New Hanover.....	550,000	25	4-4½-5
Cumberland ¹	40,000		5	Orange.....	250,000		
Davie.....	175,000			Pasquotank.....	10,000		
Edgecombe.....	16,000		6	Polk.....	⁴ 100,000	30	5½
Districts 1-5, 8-11.....	200,000	55	5	Rutherford.....	250,000	40	5
Gaston.....	300,000		4	Sampson.....	150,000	10-20	5
Granville.....	160,000	20	4½-5	Stokes ¹	35,000	30	6
Guilford.....	300,000		5	Vance.....	220,000	20-40	5
Haywood.....	60,000			Yancey.....	150,000		
Henderson.....	49,000			Total.....	5,541,273		
Hoke.....	50,000		5				

NORTH DAKOTA.

Rolette ¹	\$20,000		5	Stutsman.....	\$36,500		6
Stark.....	6,500			Total.....	63,000		

¹ Bridge bonds only.² By act of legislature, county commissioners have authority to sell bridge bonds without vote of people.³ Also 10 steel bridges.⁴ By act of legislature.

TABLE 22.—County and district highway and bridge bonds—Continued.

OHIO.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Adams.....	\$181,300	15	3½-6	Lucas.....	\$1,212,437	(6)	4-4½
Ashland.....	1258,500	10-18	4-5	Madison.....	132,250	10	5
Ashtabula.....	2309,500		4½-5	Mahoning.....	1,408,108		4-4½
Athens.....	300,000		5	District 1.....	150,000	25	5
Auglaize.....	378,000	13-26	5	Marion.....	876,175		4-4½-5
Belmont.....	94,800			Mercer.....	2,134,600		4-5-5½
Butler.....	96,000			Miami.....	91,047,000		5-6
Champaign.....	23,750			Montgomery.....	477,000		4-4½-5
Clark.....	257,662		4-5-7	Morgan.....	40,000		4
Clermont.....	110,200		4-4½-5	Morrow.....	251,728		
Columbiana.....	300,000			Muskingum.....	10920,000		5
Coshocton.....	4150,000	10	4½-5	Noble.....	48,000		
Crawford.....	8,000		4-6	Ottawa.....	82,000		5-6
District 1.....	250,000			Paulding.....	847,972	7	5
Cuyahoga.....	6,274,524		4-4½-5	Perry.....	45,000	10	5
Darke.....	223,500		4-4½	Pickaway 7.....	324,000		5
Defiance.....	5191,000	(6)	4-4½-5-6	Pike.....	69,500	3-10	5
Delaware.....	540,544		4-4½	Portage.....	224,600		4-4½
Erie 7.....	59,500		4	Preble.....	11,160		
Fayette.....	8909,000		5	Putnam.....	464,600	9	5
Franklin.....	513,260			Richland.....	205,500		4½-5
Fulton.....	204,400	5	4½	Ross.....	131,000	25-30	5
Gallia.....	542,000	2-20	4-4½-5	Sandusky.....	195,998	5	4½-5
Geauga.....	20,000		4½-5	Scioto.....	11740,000	5	4-8
Greene 7.....	41,000		4	Seneca.....	244,000		4½
Hamilton.....	917,650			Shelby 7.....	17,000		
Hancock.....	408,000			Stark.....	12605,000	5-15	5-6
Harrison.....	10,000		4½	Summit.....	509,050		4½-5½
Henry.....	937,250	5	5	Trumbull.....	13905,000		4½-5-5½
Highland.....	7,850	5	5	Tuscarawas.....	130,000	1-3	6
Hocking.....	50,000		4½	Union.....	14284,600		
Huron.....	6,500	(6)	4½-5	Van Wert.....	508,260	12-21	4-4½-5
Jackson.....	500,000			Warren 7.....	284,000	1-30	4-5
Jefferson.....	50,000			Washington 7.....	190,000	1-22	5-5½
Knox.....	61,000		4-5	Wayne 7.....	20,000		
Lake.....	278,000	20	4-4½-5	Williams 7.....	20,000		4½-5
Lawrence.....	555,000		4½-5	Wood.....	152,072,000	5	4½-5-6
Licking.....	701,000	5-15	4-5-5½-6	Wyandot.....	180,400		4½
Logan.....	30,000		4-4½	13 Districts.....	7,200	10	5
Lorain.....	598,000	18	4-5				
District 1.....	180,000	13	5	Total.....	35,241,828		

OKLAHOMA.

Carter 7.....	\$200,000			Nowata.....	\$100,000	25	5
Choctaw.....	120,000		5	Okfuskee 7.....	100,000	20	5
Coal 7.....	35,000			Osage.....	100,000		
Creek 7.....	200,000	10-25	5	Pottawatomie.....	109,000		5-5½
Delaware.....	26,000		5-6	Tulsa.....	75,000		5
Grady 7.....	60,000	20	5	Wagoner.....	75,000		
Johnston 7.....	100,000		5				
Muskogee.....	140,000		5	Total.....	1,440,000		

OREGON.

Clatsop.....	\$400,000	20	5	Multnomah.....	\$1,250,000	1-30	5
Jackson.....	500,000	10-30	5				
				Total.....	2,150,000		

¹ Of this amount \$114,000 bridge bonds.² Of this amount \$75,000 flood bonds were issued without a vote.³ Of this amount \$70,000 for bridges.⁴ Emergency road and bridge bonds.⁵ Of this amount \$65,000 used for bridges.⁶ Serial.⁷ Bridge bonds only.⁸ Of this amount \$9,000 used for bridges.⁹ \$60,000 issued under emergency act of 1913 for bridges.¹⁰ Of this amount \$775,000 used for bridges.¹¹ Of this amount \$440,000 were 5 per cent flood emergency bonds.¹² Bridge \$250,000.¹³ Bridge \$85,000.¹⁴ Emergency bonds.¹⁵ Bridge, \$6,000 emergency.

TABLE 22.—County and district highway and bridge bonds—Continued.

PENNSYLVANIA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Allegheny.....	\$15,900,000	30	3½-4½	Luzerne.....	\$2,690,000	30	4½
Beaver ²	555,000	2-12	3½-4	Lycoming.....	382,900		3-3½-4
Bedford.....	9,500			Mifflin.....	55,000		4
Berks.....	475,000	2-12	3½	Montgomery.....	725,000		3½-4
Butler.....	20,000		4	Northampton.....	300,000		3
Cameron.....	1,000			Potter.....	25,000		5
Carbon.....	50,000	5	4	Susquehanna.....	15,000		5
Clinton ²	202,500		3½-4	Venango ²	282,000		
Columbia.....	86,000		4	Washington.....	1,789,000	5-20	4½
Forest.....	10,500		5	Westmoreland.....	250,000	20	4½
Indiana.....	35,800			Wyoming ²	72,000		3½-4
Lackawanna.....	450,000	15	4-4½	York.....	103,000		
Lebanon.....	29,850			Total.....	24,839,050		
Lehigh.....	325,000						

SOUTH CAROLINA.

Dillon.....	⁴ \$100,000		5	Oconee.....	\$45,000		
Horry.....	10,000			Richland ²	75,000		
Kershaw ²	40,000			Sumter.....	50,000		
Laurens.....	50,000	30	4½	Total.....	410,000		
Marion.....	40,000		4½				

SOUTH DAKOTA.

Pennington ²	\$44,000			Stanley ⁵	\$33,300		
				Total.....	77,300		

TENNESSEE.

Anderson.....	\$300,000		4½-5	McMinn.....	\$325,000		5
Benton.....	200,000			Madison.....	500,000		4
Blount.....	300,000		5	Marion.....	170,000		4½-5
Bradley.....	216,000	25-30	5	Maury.....	175,000		
Campbell ⁶	4,000	1		Monroe.....	300,000		
Districts 1-5.....	200,000		4½-5	Montgomery.....	120,000	30	5
Carter.....	72,944		5	Morgan.....	50,000		
Elizabeth.....	65,000			Perry ⁶	19,000	7	5
Claiborne.....	70,000			Polk.....	405,000	15-30	5-6
Cocke.....	300,000		5-6	Putnam.....	250,000	30	4½
Coffee.....	4,154			Roane.....	365,000	20-30	4-5
Cumberland.....	40,000		5	Robertson.....	450,000		4
Davidson.....	250,000		4	Sevier.....	245,500	15	4½-5
Dickson.....	250,000	30	5	Shelby.....	2,792,000	12	5
Grainger.....	100,000		5	Sullivan.....	530,000	20-30	4½-5
Greene.....	800,000	30	5-6	Sumner.....	200,000	30	4½
Hamblen.....	325,000	40	5	Union.....	50,000		4
Hamilton.....	65,000			Warren.....	168,000		
Hawkins.....	220,000	65	5	Washington.....	60,000		
Hickman.....	80,000	1-12½	5½	Wayne ⁶	47,700		6
Jackson.....	250,000			White.....	90,000		
Jefferson.....	150,000	30	5	Total.....	12,474,298		
9 districts.....	395,000	25	4½-5				
Knox.....	255,000						
Loudon.....	150,000	30	5				
5 districts.....	100,000		5				

¹ Of this amount \$550,000 bridge bonds.² Bridge bonds only.³ Bridge \$100,000 payable serially, last 10 years of term.⁴ Concrete bridge, \$17,500.⁵ Certain townships only.⁶ Bridge bonds.

TABLE 22.—County and district highway and bridge bonds—Continued.

TEXAS.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Anderson.....	\$150,000	20	5	Jim Wells.....	\$125,000	10	5
Atascosa.....	20,000		3	Johnson.....	136,200		
Austin: Districts 1-3.	175,000	5-40	5	Jones ¹	7,000	20	5
Bastrop: Districts 1 and 2.....	180,000	20-40	5	Karnes.....	42,000		
Baylor.....	100,000	40	5	Kent ¹	10,000		
Bee.....	49,922	20	5	Kerr.....	40,000		
Bell.....	19,960		5	King.....	5,000		
2 districts.....	200,000	40	5½	Kinney.....	80,000		
Bexar.....	1,250,000			Knox ¹	18,500		3½-5
Borden.....	7,900		4-5	Lamar: Justice Precinct 1.....	300,000	10-40	5
Bosque: District 7.....	40,000	40	5	Lampasas ¹	45,500		4-5
Bowie.....	250,000		5	Lavaca.....	25,000		
Brazoria.....	450,000	34	4-5	Leon: Districts 1, 2, 4, 5, and 6.....	134,000		
Brooks.....	45,000	40	5	Liberty: Districts 1 and 4.....	425,000		5
Brown: District 1.....	150,000		5	Limestone: District 4	300,000	10-40	5
Burnet.....	47,000			Live Oak.....	16,990		4-5
Caldwell.....	240,000			Llano ¹	25,000		
Calhoun: Districts 1 and 2.....	235,000	40	5	McCulloch.....	118,000	40	4-5
Callahan.....	1,276		4	McLennan.....	150,000	40	3-5
Cameron: District 1.....	20,000			McMullen.....	4,000		5
Cass: District 7.....	35,000	40	5	Matagorda.....	560,000		
Chambers.....	168,000	20	5	Maverick.....	42,602		5
Childress.....	25,000		4-6	Medina.....	60,000	40	4
Coke.....	25,000			Menard.....	20,000		
Colorado.....	60,000	40	4	Midland.....	50,000		
Collingsworth.....	14,888	5-40	4-6	Milam.....	57,872		
Collin.....	450,000			Districts 2 and 5.....	200,000	40	
Comal.....	153,000	40	4-4½-5	Mills ¹	5,400		
Concho ¹	15,000		4-6	Mitchell: District 1.....	30,000	40	5
Cooke.....	1,990			Montgomery: District 1.....	250,000	40	5
District 1.....	100,000	40	5	Motley.....	25,000		
Culberson.....	50,000	40	5	Navarro: Districts 1 and 3.....	475,000	40	5
Dallas.....	1,390,000	4½		Nolan.....	100,000	40	5
Denton: District 1.....	75,000	40	5	Nueces.....	175,591		
Dewitt.....	31,998			Orange.....	200,000		5
Dickens.....	11,500	20-40	5	Palo Pinto.....	9,750		
Dimmit.....	30,000			Parker.....	25,000		4
Ellis.....	800,000			Folk.....	40,000	4	5
El Paso.....	617,000	40	4	Fotter.....	20,000		
Falls.....	100,000		3	Reeves.....	12,000		5
Fannin.....	1,900		4	Refugio: Districts 1 and 2.....	50,000		4
Fayette.....	69,500		5	Robertson.....	500,000		
Fisher.....	19,900		4	Runnels.....	57,094		5
Foard.....	83,000		3½-5	San Jacinto.....	3,000		5
Fort Bend.....	420,000		4-5	San Patricio.....	148,000		4-5
Franklin.....	500	2-50	4½	San Saba.....	38,750		4
Freestone: District 1.....	50,000		5	Shackelford.....	12,500	40	4-5
Frio.....	86,953	40	5	Sherman.....	7,000		
Galveston.....	1,500,000	40	5	Smith.....	405,000	40	5
Garza.....	50,000	40	4	Somervell.....	16,950	20	5
Gonzales: District 1.....	160,000		5	Stephens.....	18,000		
Grayson: Districts 1 and 2.....	685,000	2-50	4½	Sterling.....	10,000	40	
Gregg.....	50,000			Stonewall.....	50,000		4
Grimes.....	134,000		4-5	Sutton.....	12,000		3½
Guadalupe.....	239,500	30-40	4-4½-5	Tarrant.....	1,834,000	20-25	4-5
Hall.....	65,000		2	Taylor: District 1.....	150,000		5
Hamilton.....	22,994	5-20	4-6	Throckmorton.....	2,000		
Hardeman.....	43,500		4	Tom Green ¹	96,000	10-40	5-6
Hardin.....	169,000		5	Travis.....	482,000		4
Harris.....	1,508,000			Trinity: Districts 1 and 2.....	160,000	40	5
Haskell ¹	16,000			Upshur.....	149,000		
Hays: District 1.....	87,000		5	Valverde.....	6,000		
Hemphill.....	10,000		6	Victoria: District 2.....	200,000		5
Hidalgo.....	100,000			Waller.....	25,000		4-5
Hill.....	102,000	40-45	3½-5	Waller.....	15,000	40	5
Precinct 1.....	250,000	40	5	Walker.....	150,000		
Hood.....	36,499		4-5	Ward.....	5,000		
Hopkins.....	5,963	40	6	Webb.....	10,000		6
Houston: Districts 1 and 3.....	174,000		5	Wharton.....	320,000		3-4½-5
Howard.....	100,000		5	Wheeler ¹	15,000		4
Irion.....	20,000	40	5½				
Jackson.....	124,500		4-5½-6				
Jefferson.....	809,500	40	4½-5-6				

¹ Bridge bonds only.

TABLE 22.—County and district highway and bridge bonds—Continued.

TEXAS—Continued.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Wichita.....	\$15,000	.....	.....	Young.....	\$83,996	.....	4-5
Wilbarger.....	75,500	.....	4	Zavalla ¹	44,999	40	5
Williamson.....	300,000	.....	4½	Total.....	24,960,837	.....	.....
Wood.....	150,000	.....	5				

UTAH.

Boxelder.....	\$175,000	20	4½	San Juan.....	\$14,500	20	.....
Cache.....	45,000	.....	4	Uinta.....	8,000	20	5
Carbon ¹	30,000	20	5	Weber.....	120,000	20	4-5
Emery.....	39,500	.....	5-6	Total.....	440,500	.....	.....
Grand ¹	8,500	20	5				

VIRGINIA.

Accomac: Atlantic, and Lee.....	\$100,000	.....	5-5½	Northampton: 1 district.....	\$50,000	30	4½-5
Alleghany ¹	40,000	.....	.....	Orange.....	175,000	.....	.....
Amherst.....	215,000	20-30	4½-5	Page ¹	26,000	.....	6
Augusta: South River.....	250,000	30	5	Pittsylvania: D a n River.....	100,000	34	5
Botetourt ¹	10,000	.....	.....	Pulaski:.....			
Brunswick.....	84,000	.....	.....	Dublin.....	100,000	.....	5
Charlotte.....	100,000	.....	4½	Pulaski.....	70,000	34	5½
Clarke ¹	90,000	.....	4½	Rappahannock:.....			
Culpeper:.....				Wakefield.....	30,000	.....	5
Catalpa.....	120,000	34	5	Hampton.....	36,000	.....	.....
Stevensburg.....	45,000	.....	5	Piedmont.....	28,000	.....	.....
Dickenson:.....				Rockingham: Plains.....	30,000	10	6
Clintwood.....	54,000	2-30	.....	Russell.....	575,000	.....	5
Kenady.....	32,000	1-30	5	Scott:.....			
Dinwiddie.....	105,000	20-30	5-6	Esterville.....	100,000	20-30	5
Elizabeth City.....	30,000	.....	5-6	Fulkerson.....	33,800	.....	.....
Fairfax: Mt. Vernon.....	90,000	.....	.....	Johnson.....	33,300	20-30	5
Fauquier: Centre.....	75,000	.....	.....	Smyth: Marion, Rich Valley, and St. Clair.....	325,000	.....	5-6
Fluvanna.....	1,300	.....	.....	Spotsylvania:.....			
Giles ¹	30,000	.....	.....	Courtland a n d Chancellor.....	100,000	30	5
Greensville.....	80,000	.....	.....	Berkeley and Livingston.....	100,000	30	5
King George.....	10,000	.....	.....	Stafford.....	100,000	.....	.....
Lee:.....				Tazewell.....	625,000	.....	.....
Jonesville and 7 districts.....	440,000	6-36	5-5½	Warren: 3 districts.....	90,000	.....	6
Lunenburg:.....				Washington.....	200,000	.....	5
Plymouth.....	40,000	.....	5½-6	Westmoreland.....	25,000	.....	.....
Rehoboth.....	24,000	.....	5½-6	Wise.....	960,000	30	5
Browns Store.....	40,000	.....	5½-6	Total.....	6,632,400	.....	.....
Mecklenburg: 7 districts.....	350,000	.....	5				
Montgomery.....	30,000	.....	4				
Nelson.....	35,000	.....	7				
Norfolk.....	200,000	.....	4½				

WASHINGTON.

Asotin.....	\$35,000	.....	.....	Okanogan.....	\$15,000	.....	.....
Challam.....	401,000	.....	4½-6-7	Pacific.....	100,000	.....	5
Clarke ¹	500,000	.....	.....	Snohomish.....	80,000	20	5
Cowlitz.....	69,262	.....	.....	Delta.....	75,000	.....	.....
Jefferson.....	133,000	.....	5½	Total.....	4,408,262	.....	.....
King.....	3,000,000	.....	.....		

¹ Bridge bonds only.

TABLE 22.—County and district highway and bridge bonds—Continued.

WEST VIRGINIA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Barbour.....	\$40,000	.....	4	Marshall.....	\$150,000	.....	.....
Cabell.....	300,000	.....	4½	Monongalia.....	75,000	.....	6
Hancock:				Pleasants: St. Marys..	60,000	.....	.....
Baxter and Grant..	225,000	.....	.....	Tyler:			
Butler.....	125,000	.....	.....	Ellsworth.....	125,000	10-34	6
Harrison.....	110,000	.....	.....	Lincoln.....	200,000	10-34	6
Logan ¹	60,000	20	5	Wetzel: Grant.....	150,000	34	6
Marion:				Wood: Parkersburg..	180,000	30	4½
Fairmont.....	400,000	30	5				
Mannington.....	300,000	30	5	Total.....	2,500,000	.....	.....

WISCONSIN.

Ashland.....	\$50,000	20	4	Sauk ¹	\$40,000	20	4½
Columbia.....	20,000	10	4	Vilas.....	60,000	20	5
Florence.....	35,000	.....	5				
Iron.....	35,000	6	4	Total.....	254,000	.....	.....
La Crosse.....	11,000	.....	.....		

¹ Bridge bonds only.

TABLE 23.—Township highway and bridge bonds.

CONNECTICUT.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Fairfield:				Middlesex:			
Easton.....	\$25,000	40	3½	Chatham.....	\$70,000	.....	4
New Canaan.....	14,000	.....	4	East Haddam.....	44,000	20	3½
Stamford ¹	96,000	30	4	New Haven: Derby..	60,500	.....	3½
Wilton.....	35,000	20	4	New London: Mont-			
Hartford:				ville.....	30,000	.....	4
Plainville.....	20,000	.....	.....	Windham:			
West Hartford.....	45,000	.....	4	Brooklyn.....	28,000	25	4
Windsor.....	40,000	.....	4	Plainfield.....	30,000	.....	4
Litchfield:				Total.....	576,500	.....	.....
Barkhamsted.....	16,000	.....	3½				
North Canaan.....	23,000	.....	3½				

ILLINOIS.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Adams: Melrose.....	\$8,000	.....	.....	Clay: Stanford.....	\$900	.....	5
Bond: Central.....	6,000	.....	5	Clinton:			
Bureau:				Carlyle.....	5,000	10	4½
Greenville.....	2,700	.....	5	Germantown.....	3,105	.....	4
Ohio.....	17,500	10	5	Santa Fe.....	200	8	4
Carroll:				Coles: East-Oakland.	15,000	5	5
Fairhaven.....	2,000	.....	5	Crawford:			
Woodland.....	² 3,954	.....	5	Honey Creek.....	60,000	20-25	5
Wysox.....	38,500	1-5	5	Hutsonville.....	12,000	.....	.....
Champaign: Collax..	4,400	4-6	4½-5	Lamotte.....	58,479	20-25	5
Christian: Mount Au-				Martin.....	43,100	.....	.....
burn.....	6,000	.....	4½	Oblong.....	95,000	20-25	5
Clark:				Robinson.....	75,000	.....	.....
Anderson.....	3,000	.....	5	Cumberland: Green-			
Westfield ¹	2,250	6	6	up ¹	2,500	.....	5
York.....	3,000	.....	5	Dekalb: Malta.....	8,500	2	5

¹ Bridge bonds only.² Of this amount, \$1,200 for bridges.

TABLE 23.—Township highway and bridge bonds—Continued.

ILLINOIS—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Douglas:			<i>Per ct.</i>	Lee—Continued.			<i>Per ct.</i>
Boudre.....	\$35,000	1 13	5	Hamilton.....	\$12,800		5-6
Sargent.....	35,000	2-7	5	Harmon.....	³ 9,125		5
Dupage: Naperville..	2,300			Viola.....	13,000	1-13	5½
Edgar:				McLean: Martin.....	2,200		6
Elbridge.....	2,500		6	Macoupin: Bird.....	8,000		
Embarrass.....	35,000	10	5	Madison: Godfrey....	1,200		5
Hunter.....	1,500		5	Montgomery:			
Paris.....	35,000		5	Hillsboro.....	16,000	1 5-8	5
Effingham: Mason....	10,000		6-10	Witt.....	2,200		6
Ford: Button.....	2,500		5	Moultrie:			
Franklin:				East Nelson.....	3,500		5
Browning.....	4,500		6	Lovington ²	7,375		6
Northern.....	350		4	Ogle:			
Fulton: Orion ²	7,000		5	Maryland.....	4,500		5
Gallatin:				Pine Rock.....	2,000	13	5
Bowlesville.....	1,000	1-2	4	Rockvale.....	9,000		5
Equality.....	4,000		6	Woosung.....	15,000		5
Shawnee.....	7,000	1-5	4	Peoria:			
Greene: Woodville....	250		4	Jubilee.....	2,000		5
Grundy:				Logan ²	7,000	8	5
Goose Lake.....	2,500		5	Timber ²	1,500		6
Maine ²	5,500		5	Pike:			
Wauponsee ²	3,300		5	Derry ²	3,075		5½
Hancock:				Fairmount.....	300		
Appanoose.....	1,835		5	Hadley.....	525		
Hancock.....	6,550		5-5½	Hardin.....	1,200		
Henry:				Kinderhook.....	700		
Alba ²	3,500	6	5	Pleasant Hill.....	1,200		
Atkinson.....	5,900	10	5	Richland: German....	1,798		6
Geneseo ²	15,450	3-19	5	Rock Island: Black			
Lomine ²	2,100		5	Hawk.....	5,500		6
Phenix.....	4,250		5	St. Clair:			
Yorktown.....	2,500		5	Centerville.....	2,500		
Iroquois:				Fayetteville.....	2,000		
Belmont.....	6,000		5	Freeburg.....	7,400	10	
Chebanse ²	4,000		5	New Athens ²	8,000	12	4-5
Milford ²	10,000		5	O'Fallon.....	6,000		5
Pigeon Grove.....	5,000	10	6	St. Clair ²	3,200	4	5
Sheldon.....	37,500		5	Shiloh Valley.....	9,550	15	4-5
Jackson:				Saline:			
Carbondale.....	35,000	3-5	5	Brushy.....	1,500		5
De Soto.....	7,325		6	Cottage ²	1,694	3	6
Fountain Bluff.....	1,250		5	Galatia.....	1,400		6
Sand Ridge.....	3,900		4½	Harrisburg ²	6,215		6
Jasper:				Independence ²	800		6
Grove.....	500			Mountain.....	2,372		6
Wade.....	478			Raleigh.....	2,000		6
Jefferson:				Stonefort.....	5,000		6
Blissville ²	1,000			Sangamon: Sali-			
Farrington ²	1,000			bury ²	6,000	5	5
Jo Daviess:				Stephenson:			
Derinda.....	1,500			Jefferson.....	3,000		5
Elizabeth.....	2,500			Waddams.....	6,000		
Pleasant Valley....	10,000		5-6	Tazewell:			
Kankakee:				Hopedale ²	1,142	4	5
Ganear.....	35,000			Mackinaw ²	9,000		5½
Momence.....	35,000			Tremont.....	6,500		5
Yellowhead.....	35,000			Vermilion:			
Knox: Haw Creek....	2,500		5½	Grant.....	15,777		
La Salle:				Jamaica.....	6,500		
Deer Park.....	22,000		5½-6	Middlefork.....	5,000		
Farm Ridge.....	2,000			Washington: Bolo....	240		
Mission.....	3,750		5	Wayne:			
Utica.....	26,500		5½	Big Mound.....	11,600		6
Lake:				Leech ²	4,000	5	6
Antioch.....	4,000		5	Massilon.....	⁴ 6,125	5	6
Newport.....	9,325	28	4-5½	White:			
Lawrence:				Burnt Prairie.....	11,000		6
Bond.....	6,150		6	Emma.....	25,000		5
Denison.....	35,000	6	5	Hawthorne.....	27,500		5
Lee:				Mill Shoals.....	5,000	1-10	6
Ashton.....	44,000	20	5	Whiteside:			
China.....	25,000			Newton.....	5,820	11	6
East Grove ²	3,500	20		Portland.....	15,000	16	5
				Sterling.....	16,000		

¹ Serial.² Bridge bonds only.³ Of this amount, \$3,000 bridge bonds.⁴ Of this amount, \$3,125 for bridges.

TABLE 23.—Township highway and bridge bonds—Continued.

ILLINOIS—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Will:			<i>Per ct.</i>	Winnebago—Contd.			<i>Per ct.</i>
Channahon.....	\$5,500		5	Roscoe.....	\$35,000	5	5
Crete.....	35,000	13	5	Woodford:			6
Custer.....	3,000	3	5	Patridge.....	1,300		
Dupage.....	1,500		5	Spring Bay.....	2,700		5
Winnebago:				Total.....	1,618,634		
Cherry Valley.....	12,325		5				
New Milford.....	17,725		5-6-6½				

INDIANA.

Adams: Townships...	\$1,026,321	(²)	4½	Martin: Townships...	\$148,870	1-12	
Allen: Townships...	134,132	1-20	4½	Miami: Townships...	504,530	10-20	4½-5
Bartholomew: Townships...	780,180	10	4½	Monroe: Townships...	599,465		3½
Blackford: Townships...	1249,063	10	4½	Montgomery: Townships...	849,820		4½-6
Benton: Townships...	723,560	10	4½-6	Morgan: Townships...	393,689		4½
Boone: Townships...	127,150	10	4½	Newton: Townships...	456,125		4½-6
Carroll: Townships...	1,016,686	³ 10	4½	Ohio: Townships...	20,078		
Cass: Townships...	1692,158			Orange: Townships...	1170,541		
Clark: Townships...	1213,138	³ 10	4½	Owen: Townships...	394,089	40	4½-5
Clay: Townships...	1,004,354		4½-6	Parke: Townships...	893,367	10	4½
Clinton: Townships...	850,000	10	4½	Perry: Townships...	73,000	20	4½
Crawford: Townships...	71,806		4½-5	Pike: Townships...	152,296		
Daviess: Townships...	934,988	³ 1-20	4½	Porter: Townships...	1725,516		
Dearborn: Townships...	219,330	1-20	4½	Posey: Townships...	1473,231		
Decatur: Townships...	779,583	10	4½	Pulaski: Townships...	1270,229		
Delaware: Townships...	850,000	10	4-5	Putnam: Townships...	757,005		4½
Dubois: Townships...	216,400		4½-6	Randolph: Townships...	1517,176		4½
Fayette: Townships...	139,609		4½	Ripley: Townships...	1259,366		
Fountain: Townships...	425,000	10	4½-6	Rush: Townships...	625,742		4½-5½
Franklin: Townships...	173,820	10	3½-6	Saint Joseph: Townships...	123,500		
Gibson: Townships...	808,770	10	4½-5½	Scott: Townships...	108,856	10	4½
Grant: Townships...	760,702	10	4½	Shelby: Townships...	166,805	20	4½-6
Greene: Townships...	861,062		4½	Spencer: Townships...	137,300		4½-6
Hamilton: Townships...	525,836		4½-5	Sullivan: Townships...	1213,564		4½-5
Hancock: Townships...	255,065		4½-5	Starke: Township...	1254,429		
Harrison: Townships...	202,887		4½-5	Switzerland: Townships...	160,019		4½-5
Hendricks: Townships...	315,846		4½	Tippecanoe: Townships...	1273,930		4½-6
Henry: Townships...	47,408		4½	Tipton: Townships...	176,372		
Howard: Townships...	736,000	10	4½	Union: Townships...	79,711		4½
Huntington: Townships...	1301,289	10	4½	Vanderburg: Townships...	1137,600		4½
Jackson: Townships...	1230,000			Vermilion: Townships...	1292,132		
Jasper: Townships...	1237,195	10	4½	Vigo: Townships...	601,222		
Jay: Townships...	310,828	10	4½	Wabash: Townships...	784,220	1-20	4½
Jefferson: Townships...	135,119	20	4½-5	Warren: Townships...	1402,270		
Jennings: Townships...	417,210		4½-5	Warrick: Townships...	78,163		4½
Johnson: Townships...	127,025	10	4½	Washington: Townships...	1232,799	10	4½
Knox: Townships...	1824,496	10	4½	Wayne: Townships...	410,940	10	4½
Kosciusko: Townships...	1,440			Wells: Townships...	1473,660		
Lake: Townships...	11766,211			White: Townships...	1385,680		
Laporte: Townships...	1654,320	³ 20	4½	Whitley: Townships...	18,369		
Lawrence: Townships...	1384,630	10	4½	Total.....	35,837,348		
Madison: Townships...	849,820						
Marion: Townships...	140,735						
Marshall: Bourbon...	128,500	15	4½				

¹ Outstanding Jan. 1, 1913.² Six months.³ Serial.

TABLE 23.—Township highway and bridge bonds—Continued.

KANSAS.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Allen: Iola	\$33,000	-----	6	Mitchell: Pittsburg ¹	\$26,000	-----	5
Barton:				Neosho: Mission	32,000	-----	7
Lakin ¹	20,000	-----	6	Ottawa: Center	9,500	-----	7
Liberty ¹	6,000	-----		Pottawatomie:			
Butler: Douglass	9,000	-----	4-4½	St. Mary's	40,000	-----	4½
Cherokee: Shawnee	150,000	-----		Wamego	35,000	-----	6
Cloud:				Riley: Manhattan	12,200	-----	
Lincoln ¹	18,700	10-30	6-10	Rush: Belle Prairie	1,000	-----	6
Shirley	1,565			Sedgwick: Payne	5,000	-----	5
Sibbey	2,000	5	5	Wabaunsee: Kaw	9,000	-----	5
Comanche: Township	54,000	-----		Wilson:			
Douglas: Grant	2,500	-----		Center	7,000	-----	
Finney: Garden City	16,000	-----	6	Clifton	2,100	-----	6
Franklin: Cutler ¹	2,500	-----		Fall River	4,900	-----	
Geary: Junction City	89,600	9-10	5-6	Guilford	10,000	-----	
Hamilton: Coolidge	18,000	-----	5	Neodesha	12,000	-----	
Kingman: Bennett	17,500	30	5½	Wyandotte: Town-			
Kiowa: Glick ¹	5,000	(²)	-----	ship	5,000	-----	
McPherson: Town-							
ship	6,000	-----		Total	677,065	-----	
Marshall: St Bridget	15,000	-----	5				

MAINE.

Kennebec: Benton	\$1,500	5	4	Waldo: Frankfort ¹	\$1,000		5
Knox: Vinal Haven	2,500	-----		Washington: Jones-			
Oxford: Norway ³	35,000	35	4	port	1,000	6 mos.	6
Penobscot: Orono ¹	12,000	2-3-4	4				
Piscataquis: Foxcroft ¹	25,000	1-25	4	Total	78,000	-----	

MASSACHUSETTS.

Barnstable:				Franklin—Con.			
Barnstable	\$40,500	-----	4	Northfield ¹	\$30,000	-----	3½
Brewster	15,000	-----		Sunderland	2,500	-----	4
Harwich ¹	63,400	-----	5½	Hampden:			
Mashpee	400	-----	4	Russell	14,000	-----	4
Wellfleet	24,000	-----	3½-4	Westfield	100,000	10	4
Bristol:				Hampshire: Amherst	50,000	-----	4
Fairhaven ¹	42,000	42	4	Middlesex: Billerica	18,000	-----	4-4½
North Attleboro	6,000	1-6	5	Nantucket: Nantucket	36,000	10	5
Somerset ¹	8,000	-----	4	Norfolk: Millis ¹	5,856	3	4
Swansea	4,000	-----	4	Plymouth:			
Essex:				East Bridgewater	5,000	-----	4
Amesbury	16,000	-----	4	Plymouth	100,517	-----	4-4½
Marblehead	45,000	-----	4	Worcester: Grafton	3,800	-----	4
Franklin:							
Conway	15,000	10		Total	650,473	-----	
Gill	4,500	-----	4-4½				
Monroe ¹	1,000	-----	4				

MICHIGAN.

Alcona: Mikado	\$2,000	-----	5	Benzie: Crystal Lake	\$20,000	-----	
Allegan:				Berrien: 3 townships	89,000	-----	
Gunplain	20,000	-----	4½	Branch: Union	10,000	5	5
Saugatuck	18,000	-----	4½	Charlevoix: Hudson ¹	1,100	-----	7
Antrim:				Cheboygan:			
Banks	20,000	20	5	Benton	10,000	-----	5
Central Lake	20,000	-----		Forest	7,000	-----	6
Arenac: Au Gres	1,550	-----		Walker	5,000	-----	5
Baraga:				Chippewa:			
Arvon	10,000	-----		Sugar Isle	2,000	-----	6
Covington	18,000	-----		Trout Lake	10,000	-----	
L'Anse	25,000	-----	6	Clare: Redding	3,000	-----	5

¹ Bridge bonds only.² Serial—1989.³ For roads and sewers.

TABLE 23.—Township highway and bridge bonds—Continued.

MICHIGAN—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Crawford: 2 townships	\$16,000		<i>Per ct.</i>	Midland—Continued.			<i>Per ct.</i>
Delta:				Larkin.....	\$1,413		
Bark River.....	12,300	10	5	Mount Haley.....	1,000		5
Escanaba.....	5,000	5	5	Missaukee.....			
Ford River.....	3,000		5	Butterfield.....	4,000		6
Wells.....	10,000		5	Clam Union ¹	800		4
Dickinson: Norway..	8,000		5	Pioneer.....	6,000	3-9	5
Genesee:				West Branch.....	3,000		
Davison.....	8,300		5½	Monroe:			
Forest.....	10,000		4	Bedford.....	39,000	13	5
Montrose.....	7,000	6	5	Erie.....	40,000		
Thetford.....	10,000	10	5	Ida.....	30,000	20	5
Vienna.....	10,000		5	Whiteford.....	60,000		5
Gladwin: Bourret.....	3,500		5	Montcalm:			
Gogebic: Marenisco..	20,000	20	7	Eureka.....	725	10	5
Grand Traverse:				Montcalm.....	1,045		5
Paradise.....	30,000			Reynolds.....	10,000		5
Whitewater.....	24,000			Newaygo:			
Green Lake.....	18,000			Ensley.....	1,200		5
Hillsdale: Fayette..	3,450	1	5	Grant.....	7,500		5
Houghton: Chassell..	3,000		6	Groton.....	20,000		
Huron:				Four townships.....	39,000		
Bingham.....	2,000			Oceana:			
Bloomfield.....	2,000		6	Elbridge.....	20,000	21	5
Brookfield.....	15,000		5	Golden.....	19,500		5
Colfax.....	20,000			Greenwood ¹	1,267	3	6
Oliver.....	12,000		5	Hart.....	44,250		
Sebewaing.....	75,000			Pentwater.....	20,000		6
Windor.....	50,000	10	4½	Shelby.....	14,000		5
Ionia:				Weare.....	3,000		5
Ionia.....	12,000		5	Ogemaw: Cumming..	5,000	20	5
Lyons ¹	12,000		5	Ontonagon:			
Isabella: Vernon.....	6,000			Ontonagon.....	10,000		5
Iron:				Carr Lake.....	20,000		
Crystal Falls.....	15,000		5	McMillan.....	9,500		
Mastadon.....	20,000			Rockland.....	28,500		
Kalkaska:				Osceola:			
Clearwater.....	6,000			Burdell.....	10,000		5
Cold Springs.....	5,000			Evart.....	14,000	20	5
Springfield.....	9,000			Hartwick.....	8,000		5
Lake:				Hersey ¹	6,000		5
Ellworth.....	6,000		5	Lincoln.....	5,000		5
Newkirk.....	6,000		5	Marion.....	12,000		5
Leelanau:				Osceola.....	25,000	15	5
Empire.....	11,000		5	Otsego: Hayes.....	600		7
Leelanau.....	20,000			Ottawa: Robinson..	8,000	16	5
Townships (3).....	26,000			Presque Isle: Allis..	2,800		5
Mackinac:				Roscommon:			
Garfield.....	8,903		5	Gerrish.....	15,000		5
Hudson.....	4,000			Richfield.....	18,500	25	5
Newton.....	5,000			Saginaw:			
Macomb:				Blumfield.....	10,000		4
Lake.....	50,000			Bridgeport.....	20,000		
Warren.....	36,000			Maple Grove.....	10,000		4½
Manistee:				Richland.....	20,000		4½
Maple Grove ¹	1,100		7	St. Charles.....	10,000		5
Springdale.....	10,000			Spalding.....	5,000		4½
Stronach.....	500		5	St. Clair:			
Marquette:				East China ¹	3,000		5
Powell.....	30,000			Kimball.....	25,000		4
Wells.....	5,000		5	Sanilac:			
Mecosta: Wheatland..	1,000			Forrester.....	5,000	10	5
Mason:				Wheatland.....	5,000	5	5
Custer.....	20,000			Schoolcraft:			
Free Soils.....	15,000			Hiawatha ¹	4,000		6
Riverton.....	20,000			Mueller.....	6,000	9	5
Menominee: Stephen-				Tuscola:			
son.....	11,000	10	5-7	Ellington.....	3,832		6
Midland:				Fairgrove.....	20,000		
Edenville ¹	9,000		5	Wellington.....	4,500		
Greendale ¹	3,000		4½	Van Buren:			
Ingersoll.....	10,000	11	5	Covert.....	25,000	5	5
Jerome.....	6,500			South Haven.....	25,000	5	5
				Washtenaw: Salem..	5,000		

¹ Bridge bonds only.

TABLE 23.—Township highway and bridge bonds—Continued.

MICHIGAN—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Wayne: Redford.....	\$50,000	20-30	<i>Per ct.</i> 4½	Wexford—Contd.			<i>Per ct.</i>
Wexford:				Henderson.....	\$2,000		
Antioch.....	2,000		5	South Branch.....	2,000		5
Cherry Grove.....	5,000			Total.....	1,926,135		
Greenwood.....	5,000		5				

MINNESOTA.

Aitkin:				Goodhue:			
Cornish.....	\$6,000		4	Central Point ²	\$500		5
Fleming.....	1,200		4	Vasa ²	4,800		5
Haugen.....	7,000		4-6	Houston: Yucatan ²	2,500	5	5
Hebron.....	3,500		6	Hubbard:			
Jevne.....	4,000	20	4	Alice.....	3,000	1 10	4
Jewett.....	3,500		6	Badoura.....	200		4
Pequadna.....	3,000		6	Farden.....	1,200	10	4
Pliny.....	4,000	19	4	Guthrie.....	1,000	6-10	4
Verdon.....	1,000		6	Hart Lake.....	1,000		4
Wagoner.....	5,000		4	White Oak.....	3,000	5-20	4
Wealthwood.....	7,300		6	Isanti: Stanford ²	500		
Williams.....	7,000		4	Itasca:			
Workman.....	5,000		6	Alvwood.....	2,000	5	4
Becker: Spring Creek.....	1,500		4	Ardenhurst.....	3,500		4
Beltrami:				Balsam.....	20,000		6
Eland.....	2,000	6	4	Bass Brook.....	15,000	4-15	5½
Kelliher.....	7,000		6	Bigfork.....	8,000	20	6
Wabanica.....	3,500		4	Deer River.....	12,000		6
Benton:				Feeley.....	3,000	20	6
Alberta.....	1,100			Grand Rapids.....	10,650		5
Longola.....	3,000	1 18	4	Marcell.....	10,000	20	6
Watab.....	1,500		6	Trout Lake.....	8,500	3-21	6
Bigstone: Otrey.....	2,150	5	6	Jackson:			
Brown: Prairieville ²	2,000		6	Enterprise ²	3,000		4
Carlton:				Sioux Valley.....	3,600		4
Barnum.....	2,200	15	5	Kanabec:			
Beseman.....	8,000		6	Kroschel.....	3,400		4
Blackhoof.....	3,000	15	4	Pomroy.....	4,100	11	4
Carona.....	1,500			South Fork.....	1,500		4
Eagle.....	3,000		4	Hillman.....	3,000	10	4
Holyoke.....	10,000	15	6	Kandi yohi: Lake			
Kalavala.....	3,000	15	4	Elizabeth.....	550		
Knife Falls.....	3,000	10-15	7	Kittson:			
Lakeview.....	9,603	20	6	Davis.....	1,000	10	6
Mahtowa.....	3,000	20	4	Hallock.....	12,300		4-7-10
Red Clover.....	3,500	13	4	Perey.....	3,500		4½
Split Rock.....	3,000	13	4	Red River.....	1,100	10	7
Chippewa:				St. Vincent.....	3,000		4
Crate.....	5,000	5-20	4	Spring Brook.....	1,400	5-11	4
Lone Tree ²	3,000	20	3	Svea.....	1,000		4
Cnisago:				Teien ²	6,000		4
Rushseba ²	600	7	6	Thompson ²	7,800		4
Sunrise ²	5,000	6	4	Koochiching:			
Clay:				Bannock.....	3,000	10	4
Felton.....	6,500		4	Cingmare.....	12,000		6
Flowing.....	1,000		6	Dinner Creek.....	3,000		4
Morken.....	4,500	19	10-7	Englewood.....	2,000	1 1-20	4
Cook:				Forest Grove.....	2,000	6-16	4
Colvill.....	12,000		6	Grand Falls ²	1,500	10	6
Grand Marais.....	15,000		6	Jameson.....	10,000	20	6
Hovland.....	20,000	(1)	6	Koochiching.....	15,000		6
Maple Hill.....	15,000		6	Lindford ²	3,000	12	4
Schroeder.....	8,000	14	7	Meding.....	7,000	10	4
Cottonwood: Rose				Pine Top.....	5,000	10	6
Hill ²	2,000		4	Reedy.....	6,000	10	4
Crow Wing: Little-				Sturgeon River.....	3,000		6
pine.....	3,000	5	4	Wildwood.....	8,000	4-11	6
Dakota:				Lac Qui Parle:			
Randolph ²	2,360		5-6	Mehurin.....	2,400		4
Waterford ²	2,500	4	5	Ten Mile Lake.....	50,400		4
Dodge: Ashland.....	2,650	1	6	Lake:			
Douglas: Belle River.....	2,300		5-7	Two Harbors.....	2,500		
Fillmore: Pilot				Waldo.....	3,500		4
Mound.....	7,500		6				

¹ Serial.² Bridge bonds only.

TABLE 23.—Township highway and bridge bonds—Continued.

MINNESOTA—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Lincoln: Diamond Lake.....	\$500		<i>Per ct.</i>	Pope: New Prairie ¹	\$800		<i>Per ct.</i>
Lyons: Eidsvold ¹	1,025		8	Ramsey: White Bear Red Lake.....	12,500		4
McLeod: Collins.....	3,000		4	Lake Pleasant.....	1,000		
Rich Valley.....	1,000		6	Terrebonne.....	1,700		5
Mahnomen: Beaulieu.....	1,000		4	Redwood: Brookville.....	3,000	5-10	4
Bejou.....	1,500	20		Sundown.....	4,000		7
Heier.....	1,000		4	Renville: Crooks.....	2,500		5
Townships.....	6,600			Rice: Bridgewater ¹	3,000		5
Marshall: Alma.....	1,200	5-9	4	Flora.....	2,000	5	4
Big Woods.....	1,400		5	Rock: Denver.....	1,600		6
Donnelly.....	1,000	10	7	Kanaranzi.....	3,500		6
Lincoln.....	6,000	20	6	Luverne.....	2,500		6
Vega.....	1,300		4	Springwater ¹	8,000		6-8
West Valley.....	1,000	20	4	Roseau: Cedarbend.....	1,700		4
Millelacs: Bogus Brook ¹	2,200		4	Deer.....	4,000	20	6
East Side.....	1,500		4	Dieter.....	9,500		6
Kathio.....	12,000	20	4	Grimsted.....	6,000		
Onamia.....	4,000		4	Jadis.....	6,000		6
Page.....	7,000	9	4	Lind.....	1,600		4
South Harbor.....	3,000	(²)	4	Malung.....	1,000		6
Morrison: Hillman.....	4,000	14	4	Mickinock.....	6,600		6
Rosing ¹	800	6-13	6	Moose.....	8,600		6-7
Murray: Des Moines River.....	1,200		4	Pohlitz.....	5,000		6
Nicollet: Belgrade.....	4,000		6	Ross.....	10,000	10	6
Nobles: Townships.....	5,700	10	4	Spruce.....	5,000		6
Norman: Anthony ¹	500		4	Stallford.....	5,900	5	4-6
Good Hope.....	3,000		6	Stokes.....	9,500	20	6
Hegne.....	800	5-10	10	St. Louis: Ault.....	6,000		6
Olmsted: Rochester.....	1,769		4½	Beatty.....	3,000		4
Ottertail: Buse ¹	1,058		6	Canosa.....	10,000		10
Eagle Lake.....	400			Clinton.....	3,000	10-15	6
Maine.....	2,000		4	Mesaba.....	15,000		5½
Paddock.....	1,000			Scott: Belleplaine.....	1,500	3	5
Pennington: Elk River.....	3,000		6	Sherburne: Livonia.....	5,000		6
Rocksburg.....	1,500	10	10	Livonia.....	1,000		4
Pine: Arna.....	2,000		5	Talmer.....	2,400		5
Brookpark.....	5,540		4	Sibley: Dryden.....	1,000		
Bruno.....	14,000		5½-6	Stearns: Brackway.....	1,500		4
Chengwatana ¹	3,000		4	Grove.....	1,800		6
Danforth.....	4,000		4	Paynesville.....	3,000		4½
Fleming.....	10,000	13	6	Steele: Lemond.....	1,400		6
Kettle River.....	3,600			Stevens: Baker.....	850		
Mission Creek.....	5,000		6	Todd: Little Elk.....	5,000	7-16	4
Partridge.....	9,500		6	Wadena: Bullard.....	1,500	(²)	4
Pine City ¹	2,400	6-13	4	Huntersville.....	2,500		
Pokegama.....	1,700	10	4	Orton.....	3,000		4
Rockcreek.....	1,600		4	Wing River ¹	1,900	9	4
Wilma.....	2,500		4	Washington: Newport.....	20,000		5
Pipestone: Sweet.....	2,500		4	Watsonwan: Adrian.....	3,000	2 5	5
Polk: Fairfax.....	3,500	5-15	4	Wilkin: Andrea.....	2,000		5
Farley.....	12,000	5	4	Wright: Townships.....	3,000		4
Gentilly.....	1,000		4	Yellow Medicine: Oshkosh ¹	4,000		4
Nesbit.....	5,000	20	6	Wright.....	3,000		
Sandsville.....	1,000	10	10				
Sullivan.....	14,000		4-10				
Tabor.....	1,300		6	Total.....	982,895		

¹ Bridge bonds only.² Serial.

TABLE 23.—Township highway and bridge bonds—Continued.

MISSOURI.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Nodaway:			<i>Per cent.</i>
Polk.....	\$50,000		
Union.....	15,000	(1)	6
Total.....	65,000		

NEBRASKA.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Dawson: Lexington..	\$6,000		<i>Per ct.</i>	Platte—Continued.			<i>Per ct.</i>
Keith: Ogallala.....	26,670			Loup.....	\$3,000	15	6
Lincoln:				Oconee ²	6,000	15	6
Bostwick.....	4,000			Scotts Bluff:			
Hershey.....	20,000			Castle Rock and			
Merrick: Loup.....	3,000			Highland.....	12,000		
Morrill: Township...	14,000			Gering.....	10,000	20	5
Nance:				Winter Creek.....	15,000		
Genoa.....	82,500	20	6	Total.....	246,170		
Township.....	14,000						
Platte:							
Columbus.....	30,000						

NEW HAMPSHIRE.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Grafton: Bristol.....	\$15,000		<i>Per cent.</i>
Merrimack: Hookset ³	25,000	20	3
Total.....	40,000		4

NEW JERSEY.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Atlantic:			<i>Per ct.</i>	Camden:			<i>Per ct.</i>
Egg Harbor.....	\$95,000	8-13	4½	Delaware.....	\$7,000		5
Hamilton.....	97,000			Gloucester.....	6,000		5
Bergen:				Haddon.....	2,900		5
Franklin.....	75,000		4	Voorhees.....	2,500		5
Hillsdale.....	45,000	5	5	Cape May: Lower.....	5,000		5
Hohokus.....	22,000		4½-5	Essex: Belleville.....	87,000		4
Midland.....	30,000		5	Gloucester:			
Orvil.....	7,000		5	Monroe.....	500		5
Overpeck.....	75,500		5	Wollwich.....	3,900		5
Riverdale.....	25,000	31	5	Hunterdon: West			
Union.....	42,500	30	4	Amwell.....	4,900		4½
Washington.....	14,500		5	Monmouth: Neptune.	23,000		4½-5
Burlington:				Salem: Upper Pitts-			
Chester.....	40,000		4½	grove.....	800		5
Northampton.....	15,000	30	4	Union: Cranford.....	8,600		5
Pemberton.....	10,000		4½	Total.....	760,600		
Southampton.....	15,000	30	4½				

¹ Serial bonds.² Bridge.³ Bridge bonds.

TABLE 23.—Township highway and bridge bonds—Continued.

NEW YORK.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Allegany:				Jefferson—Contd.			
Angelic.....	\$9,000			Philadelphia.....	\$8,000		
Sciö.....	5,000			Rutland ¹	6,000		
Chautauqua:				Lewis:			
French Creek.....	3,000	3	4½	Denmark.....	6,000	6	5
Kiontone.....	4,000	4		Lowville ¹	9,000		
Westfield.....	28,000		4	Oneida:			
Chemung:				Augusta.....	10,000		
Big Flats.....	40,645		4½	Kirkland.....	11,500		
Chemung.....	20,000		4½	Paris.....	5,000		
Elmira.....	3,408		4½	Vernon.....	20,000		
Cortland:				Otsego:			
Cortlandville.....	14,000			Maryland.....	3,000		
Homer.....	4,000			Unadilla.....	5,500		
Marathon.....	4,800			Westford.....	2,500		
Delaware:				Putnam: Putnam			
Middletown.....	6,000			Valley.....	25,000	12	4½
Sidney.....	1,400			Schenectady: Prince-			
Essex:				town ¹	1,200	1-4	6
Chesterfield.....	1,500			Seneca: Lodi.....	1,200		
Keene.....	5,500			Steuben:			
Lewis ¹	6,500			Canisteo.....	1,000		
St. Armand.....	4,000			Corning.....	13,000	2-5	5
Franklin:				Rathbone.....	2,480		
Bombay.....	3,000			Suffolk:			
Malone.....	8,000			East Hampton.....	70,000	6-20	4
Moira.....	7,000			Huntington.....	17,703		
Fulton: Caroga.....	35,000	6	5	Babylon and			
Genesee: Le Roy ¹	12,000			Southampton.....	80,000		
Hamilton: Long				Tompkins:			
Lake.....	30,000			Lansing ¹	5,000	(?)	4½
Herkimer:				Trumansburg.....	25,000		
Frankfort.....	2,765	4	5½	Westchester:			
German Flats.....	6,000			Bedford.....	5,517	6-19	4-5
Herkimer.....	88,232	11	4½	Cortland.....	196,393		
Manheim.....	25,771	12	4½	Eastchester.....	259,000		4-5
Newport ¹	12,500	16	4	Greensburg.....	357,500		4
Russia.....	3,000			Harrison.....	310,600		4-4½
Salisbury.....	5,900	5	5	New Castle.....	145,693		
Schuyler.....	12,530			North Castle.....	4,578		
Webb.....	17,000	19	5	Pelham.....	18,000		
Jefferson:				Rye.....	135,000		
Clayton.....	18,000			Scarsdale.....	147,350		
Ellisburg ¹	24,000			White Plains.....	218,000		
Henderson.....	9,000						
Lyme ¹	25,000			Total.....	2,631,165		

NORTH CAROLINA.³

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			<i>Per ct.</i>				<i>Per ct.</i>
Alleghany: Township	\$50,000			Catawba:			
Anson: Wadesboro... ¹	2,000			Hickory.....	\$50,000		
Ashe: Horse Creek...	5,800			Newton.....	50,000		
Bertie: Township...	5,000			Cherokee:			
Bladen: Township...	10,000			Murphy.....	50,000	20	6
Brunswick:				Valley Town.....	47,000		5½-6
Smithville.....	35,000		5	Cleveland:			
Towncreek.....	15,000	20	5	Kings Mountain....	25,000	30	5
Buncombe: Black				Shelby.....	50,000	15	5
Mountain.....	20,000			Townships 6 and 7..	50,000		
Burke: Morganton...	50,000			Davidson: Lexington.	100,000		
Caldwell: Lovelady..	25,000			Duplin:			
Carteret:				Calypso.....	5,000		
Morehead.....	10,000	42	5	Faison.....	15,000		
Newport.....	3,000	42	5	Rosehill.....	20,000		

¹ Bridge bonds only.² Serial.³ By act of legislature, county commissioners have authority to sell bridge bonds without vote of people.

TABLE 23.—Township highway and bridge bonds—Continued.

NORTH CAROLINA—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Duplin—Continued.			<i>Per ct.</i>	Moore—Continued.			<i>Per ct.</i>
Wallace.....	\$5,000	.....	.....	Mineral Springs.....	\$10,000	.....	.....
Warsaw.....	20,000	.....	.....	Sand Hill.....	10,000	.....	6
Franklin:				Nash:			
Franklinton.....	140,000	30	5-5½	4 townships.....	40,000	.....	.....
Louisburg.....	70,000	.....	5½	Manning.....	50,000	.....	.....
Youngsville.....	55,000	.....	6	Onslow: Jacksonville.	10,000	.....	.....
Greene: 7 townships.	180,000	.....	.....	Orange: Hillsboro.	40,000	.....	.....
Halifax:				Pitt: Greenville.....	50,000	40	5
Enfield.....	60,000	.....	.....	Polk: Tryon.....	12,000	.....	.....
Halifax.....	40,000	.....	.....	Richmond:			
Haywood: Waynes-				Beaver Dam.....	10,000	.....	.....
ville.....	50,000	.....	5	Black Jack.....	5,000	.....	.....
Henderson:				Marks Creek.....	15,000	.....	.....
Edneyville.....	12,000	.....	.....	Mineral Springs.....	5,000	.....	.....
Hendersonville.....	50,000	.....	.....	Rockingham.....	25,000	.....	.....
Hoopers Creek.....	20,000	.....	.....	Steeles.....	15,000	.....	.....
Jackson:				Wolfs Pitt.....	25,000	.....	.....
Chilhowee.....	30,000	.....	.....	Scotland:			
Dillsboro.....	15,000	.....	.....	Laurel Hill.....	30,000	30	4
Lee.....	15,000	.....	.....	Spring Hill.....	20,000	.....	4
Sylva.....	30,000	.....	.....	Stewartsville.....	50,000	.....	.....
McDowell:				Williamson.....	30,000	.....	.....
Marion.....	50,000	.....	6	Stokes:			
Nebo.....	10,000	.....	6	Danbury.....	15,000	30	6
Old Fort.....	20,000	.....	6	Meadows.....	40,000	30	6
Macon: Franklin.....	100,000	.....	.....	Sauratown.....	50,000	30	6
Madison: 2 townships.	20,000	.....	.....	Surry: Mount Airy.....	85,000	30	5
Martin:				Warren: Warrenton..	50,000	.....	.....
Robersonville.....	50,000	.....	.....	Wayne:			
Williamston.....	40,000	.....	.....	Brogden.....	40,000	.....	.....
Moore:				Goldsboro.....	100,000	.....	.....
Carthage.....	8,000	.....	6	Wilson: Wilson.....	100,000	.....	.....
Deep River.....	12,500	.....	.....		
Greenwood.....	10,000	.....	.....	Total.....	2,751,300	.....	.....
McNeills.....	14,000	10-30	5-5½				

OHIO.

Adams: Wayne.....	\$7,000	.....	4	Cuyahoga—Contd.			
Ashland:				Warrensville.....	10,000	.....	.....
Montgomery.....	198,000	.....	.....	West Park.....	5,000	.....	.....
Sullivan.....	25,000	10-18	5	Erie: Grotton.....	25,000	.....	4½
Troy.....	70,000	10-18	5	Fulton: 12 townships.	392,200	.....	5
Athens:				Geauga: Hambden.....	3,000	6	4
Canaan.....	1,000	2-4	5	Hamilton: Springfield	17,500	.....	4½
Trimble 2.....	20,000	.....	.....	Harrison:			
Belmont:				Short Creek.....	9,000	.....	5
Colerain.....	25,000	.....	.....	Stock.....	2,700	.....	4-6
Pease.....	88,000	.....	5	Henry: Ridgeville.....	2,500	.....	6
Pultney.....	25,000	.....	.....	Huron:			
Warren.....	33,000	.....	.....	Bronson.....	15,500	(3)	5
Washington.....	40,000	.....	.....	Greenfield.....	4,800	(3)	6
York.....	32,000	16	5	Greenwich.....	64,000	(3)	4½
Columbiana:				Lynne.....	28,000	(3)	4½-5
Perry.....	25,000	(3)	5	New Haven.....	50,000	5	4½
St. Clair.....	20,000	23	5	New London.....	40,000	.....	4½
Crawford: Town-				Norwalk.....	25,000	.....	.....
ships.....	355,500	8-20	4-6	Norwich.....	46,000	.....	4-5
Cuyahoga:				Peru.....	15,000	(3)	4½
Bedford.....	33,500	.....	5-8½	Richmond.....	31,000	.....	6
Brecksville.....	19,000	15	4½	Ridgefield.....	35,000	.....	5
Brooklyn.....	7,000	10	5	Sherman.....	40,000	10	5
Dover.....	35,829	.....	4½	Wakeman.....	27,500	.....	4-1½
Euclid.....	32,161	24	4½	Jefferson: Springfield.	25,000	29	4½
Independence.....	5,000	.....	4½-5	Knox: Hillar.....	10,000	.....	.....
Mayfield.....	8,500	.....	4½	Lake:			
Olmsted.....	30,500	.....	4½	Painesville.....	7,500	.....	6
Orange.....	32,600	.....	4½	Willoughby.....	38,000	.....	4½
Parma.....	16,000	.....	4½	Lorain:			
Rocky River.....	30,900	8-16	4-4½-5	Brighton.....	14,000	.....	5
Royalton.....	19,725	.....	4½-5	Columbia.....	24,000	.....	4½
Solon.....	14,000	.....	4½	Grafton.....	40,000	.....	5
South Newburgh.....	35,500	.....	5	Huntington.....	11,500	.....	5
Strongsville.....	10,500	1-8	4½	Rochester.....	20,000	.....	4½

1 Flood bonds issued without vote.

2 Bridge bonds.

3 Serial.

TABLE 23.—Township highway and bridge bonds—Continued.

OHIO.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Lucas:			<i>Per ct.</i>	Scioto: Porter.....	\$10,000	9-19	<i>Per ct.</i>
Monclova.....	\$8,000	.....	5	Seneca:			4½
Springfield.....	2,000	2	6	Adams.....	10,000	10	5
Maioning:				Big Spring.....	60,500	.....	4½
Canfield.....	100,000	25	4½-5	Bloom.....	72,500	10	4½
Ellsworth.....	18,500	.....	4½	Eden.....	66,000	13	4½
Poland.....	115,000	.....	4½	Hopewell.....	38,000	.....	4½
Smith.....	100,000	.....	4½	London.....	11,000	.....	.....
Springfield.....	90,000	.....	.....	Scipio.....	27,000	.....	4
Marion: Tully.....	40,000	.....	.....	Seneca.....	47,000	.....	4
Medina:				Stark:			
Brunswick.....	22,500	.....	5	Canton.....	26,000	.....	5
Gulford.....	64,000	.....	4½	Lexington.....	10,000	.....	4
Hinckley.....	20,600	20	5	Sugar Creek.....	14,000	.....	5
Liverpool.....	19,000	12	5	Washington.....	4,000	.....	5
Medina.....	127,500	.....	4½	Summit:			
Miami:				Coventry.....	10,000	.....	.....
Brown.....	1,200	(1)	5	Hudson.....	10,000	.....	4½
Concord.....	7,000	.....	.....	Richfield.....	5,000	.....	5
Newberry.....	2,000	.....	5	Stowe.....	8,000	.....	4½
Montgomery:				Twinsburg.....	7,000	.....	4½
Clay.....	30,000	5	5	Trumbull:			
Van Buren.....	10,000	.....	5	Bristol.....	3,000	.....	6
Noble:				Fowler.....	10,000	.....	5
Caldwell.....	6,000	15-19	6	Liberty.....	100,000	.....	5
Noble.....	20,000	.....	4-5	Lordstown.....	100,000	3	4
Olive.....	20,000	.....	5	Newton.....	47,500	.....	.....
Ottawa:				Vienna.....	25,000	.....	5
Allen.....	37,000	.....	.....	Tuscarawas:			
Bay.....	24,450	.....	5	Mill.....	10,000	5	5
Catawba.....	20,000	.....	5	Perry.....	1,200	3	5
Danbury.....	25,200	.....	5	Van Wert:			
Erie.....	22,000	7-15	5	Harrison.....	125,000	25	4-4½
Harris.....	45,200	25	5	Jennings.....	21,000	.....	4
Perry: Coal.....	19,000	.....	6	Liberty.....	144,000	.....	4-4½
Pickaway:				Pleasant.....	131,000	.....	4-4½
Derby.....	17,000	.....	.....	Ridge.....	125,000	.....	4-5
Jackson.....	18,000	.....	.....	Tully.....	75,500	23	4-5
Portage:				Willshire.....	140,000	.....	4
Aurora.....	4,000	.....	.....	York.....	110,000	.....	.....
Brunfield.....	6,900	.....	.....	Vinton: Vinton.....	540	.....	4
Ravenna.....	9,000	2-10	4	Williams: Brady.....	35,000	.....	4½
Richland:				Wood: Liberty.....	50,000	5	4-5-6
Cass.....	35,000	.....	4½-5	Wyandot: Tymochtee.....	46,000	10	4½-5
Plymouth.....	61,000	.....	5				
Sharon.....	50,000	.....	5-6				
Weller.....	42,000	.....	4-5				
Sandusky:				Total.....	5,283,805	.....	.....
Ballyville.....	12,000	.....	4				
Madison.....	3,100	.....	4½				

OKLAHOMA.

Carter:				Rogers:			
Berwyn.....	\$15,000	15	6	Catoosa.....	\$3,000	25	6
Morgan.....	40,000	.....	.....	Verdigris.....	14,288	25	6
Wilson.....	10,000	.....	.....	Stephens: King.....	27,500	15	6
Creek: Sapulpa.....	50,000	20	5	Tulsa: Red Fork.....	50,000	.....	.....
Kay: Miller.....	18,000	.....	.....	Wagoner: Stonebluff.....	4,500	.....	.....
Osage:							
Bigheart.....	50,000	.....	.....	Total.....	382,288	.....	.....
Big Hill.....	50,000	.....	.....		
Strike A.x.....	50,000	.....	.....		

1 Serial.

TABLE 23.—Township highway and bridge bonds—Continued.

PENNSYLVANIA.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Allegheny:			<i>Per ct.</i>	Clinton—Contd.			<i>Per ct.</i>
Mifflin.....	\$13,000	20	5	Leidy.....	\$12,500	10	5
Reserve.....	21,000		4½-5	Logan.....	150		4½
Scott.....	10,000	8	4½	Columbia: Mount Pleasant.....	250		4
Stowe.....	20,000		4½	Crawford:			
Union.....	13,000		5	Oil Creek.....	1,700	5	5
Versailles.....	3,500		5	Wenango.....	1,960	6	5-6
Armstrong:				Cumberland: Lower Allen.....	2,350		5
East Franklin.....	4,300	17	4½	Dauphin: Jefferson.....	583		5
Kiskiminetos.....	5,500	20	5	Delaware:			
Manor.....	5,000		5	Ashton.....	12,000		4
Beaver:				Darby.....	3,500		5
Big Beaver.....	5,000	9	5	Edgemont.....	11,000		4½
Chippewa.....	1,850		6	Middleton.....	13,000		4
Dougherty.....	5,412		6	Nether Providence.....	60,000		6
White.....	1,000	4	6	Tinnicum.....	32,000		5-6
Bedford:				Upper Chichester.....	3,400		5½
Bloomfield.....	4,000	5	4	Upper Darby.....	99,800	20	4½-5
Liberty.....	400		4	Elk:			
South Woodbury.....	9,500	4-10	4-5	Benzinger.....	3,450		5
Berks:				Ridgway.....	29,000		6
Alsace.....	800			Franklin: Lurgan.....	1,000		5
Richmond.....	1,500	1	5	Fulton: Brush Creek.....	5,000		5-6
Blair:				Huntingdon: Springfield.....	365		6
Greenfield.....	5,800		4½	Indiana:			
Logan.....	35,000		5	Conemaugh.....	8,500		5
Taylor.....	4,500	20	4½	Pine.....	447		6
Bradford:				White.....	9,000		5
Armenia.....	385	3	5-6	Juniata: Greenwood.....	200		5
Terry.....	450			Lackawanna:			
Warren.....	800	1	4	Covington.....	1,500		6
Bucks:				Jefferson.....	1,100		6
Bristol.....	38,333		4	Lehigh: Whitehall.....	65,000	20	4
Middletown.....	50,000		4	Luzerne:			
Southampton.....	50,000		4	Hunlock.....	2,300		6
Butler:				Plains.....	45,000	15	5
Adams.....	3,000	6	5	Plymouth.....	15,000		5
Butler.....	5,500	15	4½	Wilkes-Barre.....	40,000		5
Cambria: Middle Taylor.....	1,250		6	Lycoming:			
Cameron:				Hepburn.....	3,000		5
Grove.....	1,600	8	6	Lewes.....	600		5
Lumber.....	2,200	3	5-6	Nippenose.....	2,380		6
Shippen.....	8,000	10	6	McKean:			
Carbon: Penn Forest.....	3,800		5-6	Annin.....	2,200		6
Center:				Ceres.....	3,000		5
College.....	2,000		5	Eldred.....	1,600		5
Gregg.....	900		5	Foster.....	6,300	2	6
Haines.....	500		5	Hamlin.....	4,108		
Half Moon.....	700		4½-5	Otto.....	1,028		6
Chester:				Mifflin: Derry.....	10,000		4
East Brandywine.....	2,100		4-5	Monroe:			
East Coventry.....	7,200		4½	Jackson.....	650		
East Goshen.....	34,500		4	Middle Smithfield.....	2,000		5-6
New Garden.....	7,200	30	5	Paradise.....	2,000	5	5
New London.....	2,000		5	Pocono.....	2,785		4-5
Penn.....	3,000		5	Polk.....	500		4
Pennsburg.....	11,000		5	Smithfield.....	7,000		5
Tredyffrin.....	12,000	9	4½	Stroud.....	6,489		
Valley.....	2,300		5	Montgomery:			
West Brandywine.....	2,000		4½	Abington.....	290,000		4-4½-5
West Calm.....	5,000		5	Cheltenham.....	155,000		3-4
West Goshen.....	2,500		4½	E. Norriton.....	4,500		5
Willistown.....	40,000		4	Horsham.....	25,000		4½
Clarion: Licking.....	400		6	Lower Gwynedd.....	16,000	23	4½
Clearfield:				Montgomery.....	8,000		4½
Bell.....	5,000		5	Springfield.....	20,000	10	4½
Burnside.....	2,000	5	5	Upper Dublin.....	85,000	3	4½
Cooper.....	1,000		6	Upper Providence.....	9,000		4½
Decatur.....	5,000		5	W. Norriton.....	12,500	20	4-4½
Ferguson.....	500			Worcester.....	22,500		4-4½
Gulich.....	3,795			Perry:			
Jordan.....	750			Jackson.....	840		5
Lawrence.....	4,900		5½	Toboyne.....	200		5
Penn ¹	2,000						
Clinton:							
Dunnstabler.....	1,400		5				

¹ Bridge bonds only.

TABLE 23.—Township highway and bridge bonds—Continued.

PENNSYLVANIA--Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Pike:			<i>Per ct.</i>	Tioga—Continued.			<i>Per ct.</i>
Greene.....	\$3,500	7	5	Deerfield.....	\$5,100	5	5
Lehman.....	1,700	6	6	Morris.....	3,357	7	6
Palmyra.....	1,200	5	5	Nelson.....	4,410		5-6
Potter:				Shippen.....	3,332		5
Bingham.....	704	6	6	Tioga.....	3,014		6
Clara.....	973	6	6	Union: Hartley.....	1,275		3-4
Eulalia.....	4,752	5	5	Venango: Allegheny.....	1,200		
Hector.....	2,500	6	6	Warren:			
Oswego.....	1,300	5	5	Conewango.....	6,600		6
Pike.....	8,774	5½	5½	Corydon ¹	1,000		5
Portage.....	1,500	6	6	South West.....	20,000		6
Stewardson.....	2,021	6	6	Spring Creek.....	600		6
W. Branch.....	2,700	5	5	Washington:			
Schuylkill:				Hanover.....	3,636		
Delano.....	500	5	5	Independence.....	20,000		6
E. Brunswick.....	1,600	6	6	Wayne:			
N. Manheim.....	6,323	6	6	Cherry Ridge.....	500		6
Rush.....	3,000	4	4	Dreher.....	4,000		4
Sullivan:				Lehigh.....	1,600		5
Colley.....	492,468			Westmoreland:			
Forks.....	800	6	6	Ligonier.....	8,000		5
Susquehanna:				N. Huntingdon.....	1,500		6
Apolacon.....	1,278	6	6	Wyoming: Northum-	1,200		6
Auburn.....	400	4	4	berland.....			
Brooklyn.....	6,000			Windham.....	550		5
Forest Lake.....	1,500	5	5	York: Fawn.....	6,000		5
Jackson.....	213	5	5				
Tioga:				Total.....	2,333,609		
Brookfield.....	3,769	4	5				

RHODE ISLAND.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Washington: South Kingston.....	\$265,000		<i>Per cent.</i>
Total.....	265,000		

SOUTH DAKOTA.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Stanley: Ashcreek.....	\$3,500	5	<i>Per cent.</i> 6
Total.....	3,500		

VERMONT.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Addison: Middlebury.....	\$1,500		<i>Per cent.</i>
Bennington: Bennington Center.....	10,000	1-13	5
Franklin:			
Berkshire.....	771		
Sheldon.....	1,050		

¹ Bridge bonds only.

TABLE 23.—*Township highway and bridge bonds—Continued.*

VERMONT—Continued.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Grand Isle:			<i>Per cent.</i>
Grand Isle.....	\$1,000	.....	.....
Isle La Motte.....	2,000	.....	.....
North Hero.....	1,000	.....	.....
Total.....	17,321	.....	.....

WISCONSIN.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
La Crosse: Onalaska.....	\$11,000	10	<i>Per cent.</i>
Sauk: Delton.....	16,000	.....	5
Total.....	27,000	.....	.....

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913.*

ALABAMA.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Blount.....			<i>Per cent.</i>	\$150,000		<i>Per cent.</i>
Crenshaw.....				125,000		
Dallas.....	\$100,000	30	5			
Hale.....	100,000					
Lawrence.....	123,000	30	6			
Marion.....				100,000	20	5
Marshall.....				130,000	30	5
Perry.....	110,000	30	5			
Russell.....	100,000	30	5			
Total.....	533,000			505,000		

ARKANSAS.

Benton.....				\$2,815	12	
Montgomery.....				10,000		
Woodruff: District 1.....				30,000	20	6
Total.....				42,815		

CALIFORNIA.

Kern.....				\$2,500,000	25	5
Orange.....	\$1,370,000		5			
Plumas.....	100,000	10-25	4			
Riverside.....				1,500,000		
San Mateo.....				1,250,000	40	5
Santa Barbara: Carpinteria.....	50,000	20	6			
Total.....	1,520,000			5,250,000		

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

DELAWARE.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Kent.....	.....	.....	<i>Per cent.</i>	\$30,000	20	<i>Per cent.</i>
New Castle.....	\$105,000	.....	4	¹ 475,000	20-51	4½
Sussex.....	.....	.....	.....	30,000	5-24	4½
Total.....	105,000	.....	.....	535,000	.....	.....

FLORIDA.

Bradford: Hampton.....	.....	.....	.....	\$25,000	20	6
Dade.....	\$250,000	.....	.....	.....	.....	.....
De Soto.....	.....	.....	.....	250,000	.....	.....
Franklin.....	20,000	20	4½	.....	.....	.....
Hernando.....	.....	.....	.....	100,000	30	5
Hillsborough.....	.....	.....	.....	1,000,000	30	5
Holmes: 1 district.....	.....	.....	.....	40,000	30	6
Lake.....	.....	.....	.....	500,000	² 15-30	6
Orange.....	200,000	.....	.....	600,000	30	5½
Palm Beach.....	200,000	.....	.....	.....	.....	.....
Pasco.....	.....	.....	.....	150,000	30	5
Pinellas.....	370,000	30	5	.....	.....	.....
Polk: Winterhaven.....	130,000	.....	.....	.....	.....	.....
Walton.....	70,000	.....	.....	.....	.....	.....
Total.....	1,240,000	.....	.....	2,665,000	.....	.....

GEORGIA.

Bleckley.....	.....	.....	.....	\$8,000	30	5
Colquitt.....	.....	.....	.....	400,000	.....	.....
Total.....	.....	.....	.....	408,000	.....	.....

IDAHO.

Ada.....	.....	.....	.....	\$200,000	10-20	5
Bear Lake.....	\$45,000	20	5½	.....	.....	.....
Boise.....	70,000	.....	.....	.....	.....	.....
Canyon.....	47,620	10	5	.....	.....	.....
Fremont: District 1.....	.....	.....	.....	120,000	10-20	6
Gooding.....	.....	.....	.....	160,000	.....	.....
Lincoln.....	.....	.....	.....	.....	.....	.....
Shoshone.....	80,000	10-20	6	.....	.....	.....
Richfield.....	.....	.....	.....	50,000	10-20	6
Twin Falls.....	.....	.....	.....	³ 100,000	10-20	5½
Total.....	242,620	.....	.....	630,000	.....	.....

¹ Bridges, \$250,000.² Serial.³ Bridges, \$50,000.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

ILLINOIS.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Carroll.....	Woodland ¹				\$1,200		5
	Wysox.....				3,500	1-5	5
Crawford.....	Honey Creek.....	\$25,000			35,000	20-25	5
	Lamott.....	20,000			35,000	20-25	5
	Oblong.....				35,000	20-25	5
	Robinson.....	25,000					
Dekalb.....	Malta.....	8,500	2	5			
Douglas.....	Boudre.....	35,000	13				
	Sargent.....	35,000	2-7	5			
Edgar.....	Elbridge.....	2,500		6			
	Embarrass.....	35,000	10	5			
Edwards: District 3.....					3,000	2	6
Fulton.....	Orion.....	7,000		5			
Gallatin.....	Bowlesville.....	1,000	1-2	4			
	Shawnee.....	7,000	1-5	4			
Jackson.....	Carbondale.....	35,000	3-5	5			
Jefferson.....	Blissville ¹	500			500		
	Farrington ¹				500		
Kankakee.....	Ganeer.....	35,000					
	Momence.....	35,000					
	Yellowhead.....	35,000					
La Salle.....	Farm Ridge.....				2,000	1	5
Lawrence.....	Dennison.....				35,000	3	5
Lee.....	Ashton.....	22,000	20	5	22,000	20	5
	China.....	25,000					
	Harmon.....				3,000		
	Viola.....				13,000	1-13	5½
Pike.....	Derry.....	3,075		5½			
	Hadley.....	525					
	Hardin.....	1,200					
	Kinderhook.....	700					
	Pleasant Hill.....	1,200					
St. Clair.....	Centerville.....	2,500					
	Fayetteville.....	2,000					
Sangamon.....	Salisbury.....	6,000	5	5			
Stephenson.....	Jefferson.....	3,000					
Wayne.....	Leech ¹				4,000	5	6
	Massilon ¹				3,125	5	6
Whiteside.....	Sterling.....	16,000					
Will.....	Crete.....				35,000	13	5
	Custer.....				3,000	3	5
Total.....		424,700			233,825		

INDIANA.

Adams.....	Blue Creek.....				\$151,550	10	4½
	French.....				15,120	(2)	4½
	Hartford.....				5,280	(2)	4½
	Kirkland.....				8,240	(8)	4½
	Monroe.....				10,160	(2)	4½
	Preble.....				25,440	(2)	4½
	Root.....				6,560	(2)	4½
	St. Marys.....				17,120	(2)	4½
	Wabash.....				6,400	(2)	4½
	Washington.....				32,940	(2)	4½
					69,740	(2)	4½
Allen.....					53,840	10	4½
	Jackson.....	\$36,320	1-20	4½			
	Lafayette.....	22,800	1-20	4½			
	Madison.....	35,930	1-20	4½			
	Maumee.....	30,842	1-20	4½			
	Monroe.....	8,240	1-20	4½			
Bartholomew.....	Townships.....	82,062			79,216	3 10-20	4½
	Clifty.....	11,520	10	4½			
	Flat Rock.....	5,000	10	4½			
	Haw Creek.....	16,500	10	4½			

¹ Bridge bonds only.² Six months.³ Serial.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

INDIANA—Continued.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Benton.....	Grant.....				\$111,560		4½
	Hickory Grove.....				11,156	10	4½
	Richland.....				2,926	10	4½
Boone.....	Perry.....	\$14,040			1,643	10	4½
	Sugar Creek.....	6,000	10	4½	39,640	10	4½
	Townships.....	2,400	10	4½			
Carroll.....	Townships.....	139,000			9,378		
Cass: Districts 1-3.....					42,400		
Clark.....	Bethlehem.....				112,425	10	4½
	Carr.....	9,440	10	5			
	Charlestown.....	13,700	10	5			
	Jeffersonville.....	43,400	10	5			
	Monroe.....	38,100	10	5			
	Union.....	29,506	10	5½			
	Washington.....	14,316	10	5			
	Wood.....	17,948	10	5			
Clay.....		9,010	10	5			
	Perry.....	9,000		4½	73,800	10	4½
Crawford.....	Ohio.....	6,824		4½			
Daviess.....					90,000	10	4½
	Madison.....				56,738	10-20	4½
	Reeve.....				21,000	1-20	4½
Dearborn.....		66,063			40,000	1-20	4½
	Center.....				40,000	20	4½
	Harrison.....	11,320	1-20	4½			
	Miller.....				50,000	10-20	4½
Decatur.....					163,880	10-15	4½
Delaware.....					100,000	10-20	4½
Fayette.....					24,000	10	4½
Fountain.....		122,750			15,200	10	4½
Gibson.....					77,300	10	4½
	Center.....				5,600	10	4½
	Montgomery.....				26,400	10	4½
	Patoka.....				18,000	10	4½
	Union.....				27,300	10	5½
Grant.....	Townships.....	550,000	10	4½			
Greene.....					42,499	10	4½
Hamilton.....	White River.....	6,320					
Hancock.....					35,500	1-10	4½-6
Harrison.....					43,220	20	4½
	Harrison.....	7,100		4½			
	Taylor.....	9,200		4½			
Henry.....		10,200		4½			
	Franklin.....	9,200		4½			
Howard.....	Union.....				215,000	10	4½
Huntington.....		52,988	10	4½	39,653	10	4½
	Jackson.....				22,425	10	4½
Jackson.....					29,640	10	4½
Jasper.....	Hanging Grove.....	5,800	10	4½			
	Keener.....	18,000	10	4½			
	Townships.....				68,910	10	4-6½
Jay.....					50,370	10	4½
Jefferson.....	Township.....				3,000	20	4½
Jennings.....					14,300	10	4½
Johnson.....	Townships.....				93,400	10	4½
Knox.....	Vincennes.....				189,360	10	4½
Kosciusko.....		1,440	10	4½			
Laporte.....					208,000	20	4½
Madison.....		99,380	10	4½			
3 districts.....					76,120	10	4½
	Fall Creek.....				6,240	20	4½
Marion.....					228,000	10-20	4½
Marshall.....					57,000	15	4½
	Bourbon.....	28,500	15	4½			
Martin.....		30,000			4,300		4½
	Baker.....	5,092	12				
Miami.....		32,550	10-20	4½	70,880	10-20	4½-5
Monroe.....		96,319					
Morgan.....		21,000	10	4½	48,200	10	4½
Ohio.....					9,000	10	5

¹ Bridge bonds, \$30,000.³ Bridge, \$15,000.⁵ Bridge, \$200,000.² Bridges, \$25,000.⁴ Serial.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

INDIANA—Continued.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Owen.....				<i>Per ct.</i>	\$24,159	20	<i>Per ct.</i>
Parke.....	Marion.....	\$8,972	40	4½			
Perry.....	Adams.....				22,658	10	
Pike.....	Troy.....	73,000	20	4½			
Putnam: Districts 1-3.....	Townships.....				21,000	20	6½
Rush.....					58,689	10	4½
					259,000	10-20	4½
St. Joseph.....	Walker.....	39,800		4½			
Scott.....		60,000	16	4	24,000	10	4½
Shelby ¹	Jennings.....	8,000	10	4½			
					80,000	20	4½
Spencer.....	Shelbyville.....	51,940		4½	28,920	20	4½
Starke.....	Ohio.....	14,320					
Sullivan.....					41,000	10	4½
	Jackson.....	17,960		4½	80,982	10	4½
Switzerland.....		22,931	10	4½			
Tippecanoe ¹					260,000	10	4½
Tippton: Districts 1-3.....					44,080	10	4½
Vanderburg.....					92,600	10	4½
Vigo.....					33,800	(²)	4½
Wabash.....					145,320	10	4½
	Liberty.....				10,960	10	4½
	Noble.....				67,540	10	4½
	Pawpaw.....				12,660	10	4½
Wayne.....	Green.....	12,000					
	4 townships.....				58,660	10	4½
Wells.....	Wayne.....	127,500			146,000	10	4½
White.....		105,640					
		57,600			93,000	10	4½
Total.....		2,384,783			4,701,997		

IOWA.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Boone.....	\$25,450	12	<i>Per cent.</i>			<i>Per cent.</i>
Dallas.....			4½			
Fremont ¹				³ \$67,000		
Jackson ¹				⁴ 100,000	20	5
Madison.....				⁵ 108,000	20	5
Wright ¹				28,000	² 3-17	5
				45,000	7-15	5
Total.....	25,450			348,000		

¹ Bridge bonds only.² Serial.³ General funding bonds including gravel roads.⁴ By order of Board of Supervisors.⁵ To fund outstanding bridge warrants.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

KANSAS.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Geary.....		\$86,150 ^a	10	<i>Per ct.</i> 6			<i>Per ct.</i>
Kiowa.....	Junction City.....	89,600	9-10	5-6			
Marion.....	Glick.....	5,000	(1)	5			
Sedgwick.....					\$6,000	5-11	6
Wilson.....					1,550	10	5
Wyandotte.....	Center.....	7,000					
	Guilford.....	10,000					
		189,000	(2)	4½			
Total.....		386,750			7,550		

KENTUCKY.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Lewis.....			<i>Per cent.</i>			<i>Per cent.</i>
Robertson.....	\$8,000	5-8	5	\$800		
Total.....	8,000			800		

LOUISIANA.

Parishes ³ and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Assumption.....			<i>Per cent.</i>			<i>Per cent.</i>
Bossier.....				\$80,000	9	5
Calcasieu.....				175,000	1-40	5
East Baton Rouge: District 1.....				900,000	25	5
Iberville: Districts 1, 5, and 6.....	\$13,009	1-10	10	37,000	10-20	5
Jefferson.....	200,000		5			
Lafayette.....				75,000	25	5
Tangipahoa: District 2.....				75,000	30	5
Washington.....				39,477	2-4	5½
Total.....	213,009			1,381,477		

MAINE.

Counties.	Towns.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Kennebec.....	Benton.....			<i>Per ct.</i>			<i>Per ct.</i>
Knox.....	Vinal Haven.....				\$1,500	5	4
Oxford.....	Norway ⁴				2,500		
Penobscot.....	Orono ⁵				35,000	35	4
Piscataquis.....	Foxcroft.....	\$25,000	1-25	4	12,000	2-4	4
Waldo.....	Frankfort ⁵				1,000		5
Washington.....	Jonesport.....				1,000	(6)	6
Total.....		25,000			53,000		

¹ Serial to run until 1918.² Serial to run from 1932 to 1941.³ Parishes are equivalent to counties.⁴ For roads and sewers.⁵ Bridge bonds.⁶ Six months.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

MARYLAND.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Caroline.....	.....	.....	<i>Per cent.</i>	.....	.....	<i>Per cent.</i>
Montgomery: 5 districts.....	\$47,000	.....	.....	¹ \$35,000	20	5
Queen Anne.....	50,000	.....	.....	25,000	25	4½
Talbot.....	.....	.....	.....	.....	.....	.....
Worcester.....	.....	.....	.....	30,000	.....	.....
	.....	.....	.....	25,000	25	5
Total.....	97,000	.....	.....	115,000	.....	.....

MASSACHUSETTS.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Barnstable ².....	.....	.....	.....	<i>Per ct.</i>	\$14,000	.....	<i>Per ct.</i>
Berkshire.....	.....	.....	.....	.....	5,000	1-2	4
Bristol.....	North Attleboro ..	\$6,000	1-6	4	7,000	1-3	4½
Essex.....	.....	.....	.....	.....	120,000	.....	.....
Hampden.....	Russell.....	5,000	.....	4	.....	.....	.....
Middlesex.....	BillERICA.....	9,000	.....	.....	.....	.....	.....
Nantucket.....	.....	.....	.....	.....	20,000	5	4
Norfolk ²	Nantucket.....	20,000	10	5	.....	.....	.....
	Millis.....	2,400	3	4	50,000	(³)	4.92
Plymouth ².....	.....	.....	.....	.....	20,000	.....	4
Total.....	.....	42,400	.....	.....	236,000	.....	.....

MICHIGAN.

Antrim.....	Banks.....	.....	.....	.....	\$20,000	⁴ 20	5
Baraga.....	Central Lake.....	.....	.....	.....	20,000	.....	.....
Benzie.....	Arven.....	\$10,000	.....	.....	.....	.....	.....
Berrien.....	Crystal Lake.....	.....	.....	.....	20,000	.....	.....
	.....	.....	.....	.....	500,000	15	4
	3 townships.....	.....	.....	.....	89,000	.....	.....
Delta.....	.....	100,000	(⁴)	4½	.....	.....	.....
Emmet.....	.....	.....	.....	.....	225,000	.....	.....
Genesee.....	.....	500,000	20	4½	200,000	⁴ 10	4½
Gogebic.....	.....	150,000	10	4½	.....	.....	.....
Grand Traverse.....	Paradise.....	30,000	.....	.....	.....	.....	.....
	Whitewater.....	.....	.....	.....	24,000	.....	.....
Huron.....	Sebewaing.....	75,000	.....	.....	.....	.....	.....
	Windsor.....	50,000	.....	.....	.....	.....	.....
Ingham.....	.....	.....	.....	.....	63,652	.....	.....
Kalkaska.....	Clearwater.....	6,000	.....	.....	.....	.....	.....
	Coldspring.....	5,000	.....	.....	.....	.....	.....
	Springfield.....	9,000	.....	.....	.....	.....	.....
Kent.....	.....	.....	.....	.....	265,000	20	4½
Lake.....	Ellsworth.....	6,000	5	.....	.....	.....	.....
Leelanau.....	Leelanau.....	20,000	.....	.....	.....	.....	.....
	3 townships.....	.....	.....	.....	26,000	.....	.....

¹ Bridge built from part of this amount.² Bridge bonds only.³ Nine months.⁴ Serial.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.*

MICHIGAN—Continued.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Mackinac.....				<i>Per ct.</i>	\$100,000	10-20	<i>Per ct.</i> 5
	Hudson.....	\$1,000					
	Newton.....	5,000					
Macomb.....	Lake.....	50,000					
	Warren.....	36,000					
Mason.....	Free Soil.....	10,000					
Midland.....					56,000	15	5
Montcalm.....	Eureka.....	500	10	5			
Newago.....	Groton.....				20,000		
Oceana.....	Golden.....	3,000		5			
Ontonagon.....					38,000	10	5
Osceola.....	Lincoln.....				5,000		
Ottawa.....		600,000	20	4½			
Tuscola.....	Fairgrove.....				20,000		
	Wellington.....				4,500		
Van Buren.....	Covert.....				25,000		
Wexford.....	South Haven.....	25,000	5	5			
	Henderson.....	2,000					
Total.....		1,696,500			1,721,152		

MINNESOTA.

Beltrami.....					\$81,000	20	4
Carlton.....	Blackhoof.....	\$3,000	15	4			
	Corona.....	1,500	15	4			
	Mahtowa.....	3,000	20	4			
	Red Clover.....	2,000	13	4			
	Split Rock.....	3,000	13	4			
Kittson.....	Thompson.....	7,000		4			
Koochiching.....	Bannock.....	3,000	10	4			
	Meding.....	7,000	10	4			
	Reedy.....	6,000	10	4			
McLeod.....	Collins.....	3,000	6-15	4			
Marshall.....	Alma.....	1,200	5-9	4			
	Big Woods.....	800	5	8			
Millelacs.....	Page.....	5,000	9	4			
Ramsey.....	White Bear.....	7,500		4			
Winona.....					50,000	5-7	5
Total.....		53,000			131,000		

MISSISSIPPI.

Counties and beats.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			<i>Per cent.</i>			<i>Per cent.</i>
Adams: Beat 1.....	\$150,000					
Attala.....	50,000	25	5			
Calhoun.....	40,000	25	6			
Beat 1.....	60,000	25	6			
Chickasaw: Beat 3.....	50,000	20	5	\$150,000	20	5
Claborn.....				10,000	20	5
Clay:						
Beats 1-3.....	141,000					
Beat 2.....				20,000	10-25	6
Coahoma.....	50,000	30	5			
Copiah.....	159,000					
Beat 2.....				75,000	25	6
Covington.....	50,000					
De Soto: Beats 1, 2, 3, and 5.....	250,000					
Forrest.....	100,000	10-25	5			
Beats 1 and 3.....				100,000	40	5

¹ Serial.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

MISSISSIPPI—Continued.

Counties and beats. ¹	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
George.....	\$30,000	30	<i>Per cent.</i> 6			<i>Per cent.</i>
Greene.....				\$10,000	1-10	6
Grenada.....	45,000	20	5			
Hancock.....	100,000	20	6	50,000	20	6
Hinds: Beats 1 and 5.....				200,000	25	5
Issaquena.....				20,000	40	6
Itawamba.....				65,000		
Jackson.....	65,000					
Jasper.....	25,000	25	5			
Jones: Beat 2.....				50,000	25	5
Lafayette.....	180,000	25	5½-6			
Lamar.....	51,000			20,000		
Lauderdale: Beat 5.....	50,000	30	5	100,000	30	5
Lee:						
Beats 1 and 3.....	50,000	25	5½			
Beats 1 and 2.....				80,000	25	5½-6
Leflore.....				100,000	20	5
Lowndes: Beat 2.....				50,000	10-20	5
Monroe: Beats 1, 4, and 5.....	50,000	25	5			
Montgomery: Beat 1.....	40,000	10-20	5			
Neshoba.....				100,000		
Noxubee.....				380,000		
Beats 1, 2, 3, and 5.....	377,500	25	5½			
Panola.....				50,000		6
Pike.....				200,000		
Pontotoc.....				5,000	20	
Prentiss: Beat 1.....	50,000	20	6	40,000	25	6
Quitman.....				25,000		
Rankin: Beat 2.....				10,000		
Scott: Beat 1.....	75,000	20	6			
Simpson: Beats 1 and 2.....				40,000	20	5½
Tallahatchie.....	25,000	25	6			
Beats 1-5.....				75,000	25	6
Warren.....	65,400	20	5	300,000		
Yalobusha:						
Beats 1 and 4.....	25,000	25	5½			
Beats 2 and 4.....				48,000	25	5½-6
Yazoo: 4 beats.....				77,500	25	6
Total.....	2,403,900			2,450,500		

MISSOURI.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Boone: Harg.....		\$20,000	10	<i>Per ct.</i> 6			<i>Per ct.</i>
Cedar.....		19,000	2-15	5½			
Clay: 2 districts.....		135,000					
Dade: 1 district.....		30,000					
Greene.....		12,000			\$78,000		
Grundy.....					5,000		6
Howell.....		30,000					
Laclede.....		50,000					
Lawrence: Mount Vernon.....		50,000	15	5			
Mississippi: 1 district.....		7,000					
New Madrid: King's Highway and Malden Risca.....		20,000					
Newton: Neosho.....					30,000	15	6
Nodaway.....	Polk ³	15,000	(²)	6	50,000		
Stone: 1 district.....		10,000	17	6			
Total.....		398,000			163,000		

¹ Counties subdivided into beats and districts.² Serial.³ Bridge bonds only.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

MONTANA.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Blaine.....	\$40,000	20	<i>Per cent.</i> 5	.....	.....	<i>Per cent.</i>
Cascade.....	60,000	.....	.....	.....	.....	.....
29 districts ¹.....	.....	.....	.....	\$45,000	20	5
Custer.....	170,000	20	4½	.....	.....	.....
Lincoln.....	125,000	20	5	.....	.....	.....
Musselshell.....	80,000	20	5	.....	.....	.....
Sanders: 20 districts.....	.....	.....	.....	15,000	² 5-20	5
Teton.....	100,000	5-20	5	.....	.....	.....
33 districts.....	.....	.....	.....	³ 100,000	20	5
Total.....	575,000	.....	.....	160,000	.....	.....

NEBRASKA.

Lincoln.....	.....	.....	.....	\$15,000	.....	.....
Scotts Bluff: Precincts.....	\$10,000	20	5	.....	.....	.....
Total.....	10,000	.....	.....	15,000	.....	.....

NEW JERSEY.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Atlantic.....	\$30,000	.....	<i>Per ct.</i>	.....	.....	<i>Per ct.</i>
.....	Egg Harbor.....	30,000	8-13	4½	.....	.....	.....
Bergen.....	11,000	30	4½	.....	.....	.....
Camden.....	57,000	5	4½	.....	.....	.....
Cape May.....	53,500	30	4½	\$70,000	30	4½
Cumberland.....	9,000	9	4½	.....	.....	.....
Essex.....	100,500	40	4	.....	.....	.....
Gloucester.....	130,000	1-13	4½	.....	.....	.....
Hudson.....	320,666	.....	⁴ 4½	.....	.....	.....
Hunterdon.....	45,000	25	4	84,000	30	4
Mercer.....	40,500	20-30	4	14,500	30	4½
Middlesex.....	48,000	.....	4½	143,500	.....	.....
Ocean.....	35,000	30	5
Passaic.....	⁴ 136,000	14-18	5
Sussex.....	17,600	.....	.....	.....	.....	.....
Warren.....	30,000	5-10	4
Total.....	892,766	.....	.....	513,000	.....	.....

NEW MEXICO.

County.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Dona Ana.....	<i>Per cent.</i>	\$100,000	32	<i>Per cent.</i> 5

¹ Bridge bonds only.² Serial.³ Bridges. \$30,000.⁴ Bridge. \$26,000.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

NEW YORK.

Counties.	Towns.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Cayuga.....					\$29,777	1-20	4½-5
Chautauqua.....	French Creek.....	\$3,000	3	4½			
	Kiantone.....	4,000	4				
Chemung.....	Big Flats.....	7,000		4½			
	Chemung.....	20,000		4½			
	Elmira.....	3,408		4½			
Essex.....	Chesterfield.....	1,500					
	Keene.....	3,000					
Fulton.....	Caroga.....	35,000	6	5			
Greene.....		45,500					
Herkimer.....	Fairfield.....				5,000		
	Frankfort.....	2,765	4	5½			
	German Flats.....	6,000					
	Herkimer ¹	20,732	11	4½	67,500		4.6
	Manheim.....	19,771	12	4½			
	Newport.....	8,000	16	4			
	Russia.....	3,000					
	Salisbury.....	5,900	5	5			
	Schuyler.....	12,530					
	Webb.....	17,000	19	5			
Lewis.....		12,362	25	5			
	Lowville.....	9,000					
Livingston.....					12,750	4	4½
Nassau.....		240,000	5-20	4½	500,000	6-20	4½-4.7
Niagara.....					4,000		
Oneida.....	Kirkland.....	5,400					
Orleans.....		21,750	6	5			
Otsego.....	Maryland.....	3,000					
	Westford.....	2,500					
Putnam.....					38,000	15	4½
Rensselaer.....		150,000			81,000		
St. Lawrence.....		125,000	4-9	4			
Schenectady.....	Princetown ¹				1,200		
Seneca.....					20,335	10	4.7
Steuben.....	Corning.....	4,000	2-5	5			
Suffolk.....					55,000	13½	4½
Tompkins.....		23,000	(1)	4½			
	Lansing.....	5,000	(1)	4½			
	Trumansburg.....	10,000					
Warren.....		50,000	11	5			
Westchester.....		89,560			2 30,000	20-25	
	Eastchester.....	46,500		4-5			
	New Castle.....	141,500					
	White Plains.....	30,000					
Total.....		1,186,678			844,562		

NORTH CAROLINA.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Anson.....		\$50,000			\$50,000		
Beaufort.....					3 50,000		
Brunswick.....					40,000		
Buncombe.....					50,000		5-6
Burke.....	Morganton.....				50,000		
Cabarrus.....		105,000					
Caldwell.....	Lovelady.....				25,000		
Carteret.....	Morehead.....				10,000	42	5
	Newport.....				3,000	42	5
Catawba.....	Hickory.....	50,000					
	Newton.....	50,000					

¹ Serial.² Bridge bonds only.³ By act of legislature county commissioners have authority to sell bridge bonds without vote of people.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

NORTH CAROLINA—Continued.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Cherokee.....		\$187,000		<i>Per ct.</i>			<i>Per ct.</i>
Cleveland.....					\$60,000	40	
Davie.....	Townships.....	25,000	15	5	50,000		
Duplin.....	Calypso.....	5,000			175,000		
	Faison.....	15,000					
	Rosehill.....	20,000					
	Wallace.....	5,000					
	Warsaw.....	20,000					
Edgecombe: Districts 1, 2, 3, 4, 5, 8, 9, 10, and 11.					200,000	55	
Franklin.....	Franklington.....	20,000	20	5-5½	20,000		
	Youngsville.....	15,000					
Granville.....		40,000					
Greene.....	Voted by all townships, except 3.				180,000		
Halifax.....	Enfield.....				60,000		
	Halifax.....				40,000		
Haywood.....	Waynesville.....	50,000		5			
Henderson.....		24,000			25,000		
	Edneyville.....				12,000		
	Hendersonville.....				50,000		
	Hoopers Creek.....				20,000		
Iredell.....		400,000					
Jackson.....	Cullowhee.....				30,000		
	Dillsboro.....				15,000		
	Sylva.....				30,000		
Lee.....		100,000	40	5			
Lincoln.....					200,000	40	
McDowell.....	Marion.....				50,000		6
	Nebo.....				10,000		6
	Old Fort.....				20,000		6
	Franklin.....				100,000		
Macon.....					300,000		
Madison.....	Township.....	10,000					
Martin.....	Robersonville.....				50,000		
Moore.....	Deep River.....				12,500		
	Greenwood.....				10,000		
	Mineral Springs.....				10,000		
Nash.....	Rocky Mount.....	20,000					
	Mannings.....				50,000		
New Hanover.....					1 350,000	25	
Onslow.....	Jacksonville.....				10,000		
Orange.....		250,000					
Pitt.....	Greenville.....				50,000	40	5
Polk.....					2 100,000	30	
Richmond.....	Beaver Dam.....	10,000					
	Black Jack.....	5,000					
	Marks Creek.....	15,000					
	Mineral Springs.....	5,000					
	Rockingham.....	25,000					
	Steeles.....	15,000					
	Wolf Pitt.....	25,000					
Rutherford.....					250,000	40	
Sampson.....		10,000			100,000	20	
Scotland.....	Stewartsville.....	50,000					
	Williamson.....	30,000					
	Laurel Hill.....	30,000	30	4			
	Spring Hill.....	20,000		4			
Stokes.....	Danbury.....				15,000	30	6
	Meadows.....				40,000	30	6
	Sauratown.....				50,000	30	6
Surry.....	Mount Airy.....	5,000	30	5	80,000		
Vance.....					200,000	20-40	
Warren.....	Warrenton.....				50,000		
Wayne.....	Brogden.....				40,000		
	Goldsboro.....				100,000		
Yancey.....					150,000		
Total.....		1,706,000			3,642,500		

1 Including \$250,000 for bridges.

2 By act of legislature.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

OHIO.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Ashtabula.....	Sullivan.....	.....	.....	.....	\$194,000	10	5
Ashtabula.....	Troy.....	.....	.....	.....	25,000	10-18	5
Auglaize.....	.....	.....	.....	.....	70,000	10-18	5
Belmont.....	Washington.....	\$40,000	.....	5	¹ 75,000	.....	.....
Belmont.....	York.....	14,000	16	5	² 78,000	13-26	5
Coshocton.....	.....	.....	.....	.....	.....	.....	.....
Cuyahoga.....	.....	2,003,220	1-30	4½	³ 100,000	10	5
Defiance ⁴	Euclid.....	4,000	24	4½	1,000,000	1-31	5
Erie.....	Groton.....	25,000	.....	4½	65,000	4-65	5
Fayette ⁴.....	.....	.....	.....	.....	9,000	(⁵)	5
Fulton.....	.....	.....	.....	.....	30,000	5	5
Gallia.....	.....	.....	.....	.....	14,000	2-8	5
Hancock.....	.....	120,500	.....	.....	.....	.....	.....
Henry.....	.....	.....	.....	.....	28,750	5	5
Highland: 2 districts.....	.....	.....	.....	.....	7,850	5	5
Huron.....	Norwalk.....	20,000	.....	.....	.....	.....	.....
.....	Ridgefield.....	20,000	.....	5	.....	.....	.....
.....	Sherman.....	25,000	10	5	.....	.....	.....
Lake.....	.....	.....	.....	.....	62,000	20	4½
Lawrence.....	.....	.....	.....	.....	30,000	4½-5	.....
Licking.....	.....	210,000	.....	.....	⁶ 374,000	5-25	5-5½
Lorain: District 1.....	.....	.....	.....	.....	180,000	13	5
.....	Four townships.....	175,000	.....	.....	.....	.....	.....
Lucas.....	.....	139,535	.....	.....	.....	.....	.....
Madison ⁴.....	.....	.....	.....	.....	80,000	10	5
Mahoning.....	Springfield.....	40,000	.....	.....	.....	.....	.....
District 1.....	.....	.....	.....	.....	150,000	25	5
Mercer.....	.....	.....	.....	.....	54,600	.....	5-5½
Miami.....	.....	.....	.....	.....	60,000	.....	.....
Montgomery.....	.....	.....	.....	.....	330,000	.....	5
Muskingum.....	.....	.....	.....	.....	⁷ 875,000	.....	5
Noble.....	Caldwell.....	10,000	.....	4-5	6,000	15-21	6
.....	Noble.....	20,000	.....	.....	.....	.....	.....
Ottawa.....	Catawba.....	20,000	.....	.....	.....	.....	.....
.....	Danbury.....	8,400	.....	5	.....	.....	.....
Paulding.....	.....	24,000	.....	.....	134,300	7	5
Perry.....	.....	.....	.....	.....	45,000	10	5
Pike.....	.....	.....	.....	.....	14,000	2-13	5
Portage.....	Brumfield.....	6,900	.....	.....	.....	.....	.....
Putnam.....	.....	155,000	5-10	5	.....	.....	.....
Ross.....	.....	.....	.....	.....	⁸ 86,000	25-30	.....
Sandusky.....	.....	.....	.....	.....	⁹ 37,650	5	5
Scioto.....	.....	.....	.....	.....	¹⁰ 440,000	.....	5
Stark.....	.....	.....	.....	.....	¹¹ 545,000	5-15	5
Summit ⁴.....	.....	40,000	.....	.....	23,000	.....	.....
Trumbull.....	.....	.....	.....	.....	¹² 245,000	.....	5
Districts 1 and 2.....	.....	60,000	.....	.....	.....	.....	.....
.....	Vienna.....	25,000	.....	5	.....	.....	.....
Tuscarawas: 68 districts.....	.....	.....	.....	.....	130,000	1-3	6
Union.....	.....	.....	.....	.....	53,600	.....	.....
Van Wert.....	.....	.....	.....	.....	16,600	12-21	5
.....	Tully.....	15,900	23	4-5	.....	.....	.....
Warren ⁴.....	.....	.....	.....	.....	262,000	1-30	4-5
Washington ⁴.....	.....	.....	.....	.....	190,000	1-22	5-5½
Wayne ⁴.....	.....	.....	.....	.....	20,000	.....	.....
Williams ⁴.....	.....	.....	.....	.....	5,000	.....	5
Wood.....	.....	.....	.....	.....	¹³ 156,000	5	5
Wyandot.....	Tymochtee.....	20,000	4½-5	.....	.....	10	5
Districts.....	.....	.....	.....	.....	7,200	.....	.....
Total.....	.....	3,221,455	.....	.....	6,308,550	.....	.....

¹ Flood bonds.² Bridge \$70,000.³ Emergency road and bridge bonds.⁴ Bridge bonds only.⁵ Nine months.⁶ Bridge \$24,000.⁷ Of this amount \$775,000 for bridges.⁸ Bridge and refunding bonds.⁹ Bridge \$25,000.¹⁰ Flood and emergency bonds, by authority of H. B. 640.¹¹ Bridge \$190,000.¹² Bridge \$85,000.¹³ Bridge \$6,000.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

OKLAHOMA.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Carter.....	Berwyn.....				\$15,000	15	6
Creek.....	Sapulpa.....				50,000	20	5
Rogers.....	Catoosa.....				3,000	25	6
	Verdigris.....				14,288	25	6
Stephens.....	King.....	\$27,500	15	6			
Wagoner.....		75,000					
Total.....		102,500			82,288		

OREGON.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			<i>Per cent.</i>			<i>Per cent.</i>
Clatsop.....				\$400,000	20	5
Jackson.....				500,000	10-30	5
Multnomah ¹				1,250,000	1-30	5
Total.....				2,150,000		

PENNSYLVANIA.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Allegheny.....					\$1,550,000	30	4½
Berks.....		\$475,000	2-12	3½			
Cameron.....	Lumber.....	600	3	5-6			
	Shippen.....	3,000	10	6			
Carbon; Districts (55).....					50,000	5	4
Lackawanna.....					200,000	15	4½
Luzerne.....					² 260,000	30	4½
McKean.....	Ceres.....	1,000		5			
	Hamlin.....	4,108					
Potter.....					25,000		5
Sullivan.....	Forks.....	800		6			
Washington.....					220,000	1-20	4½
Westmoreland.....					250,000	20	4½
York.....					35,000		
Total.....		484,508			2,590,000		

RHODE ISLAND.

County.	Town.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Washington.....	South Kingston...	\$100,000					

¹ Bridge bonds only.² Bridge \$100,000.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

SOUTH CAROLINA.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Laurens.....	\$50,000	.....	<i>Per cent.</i> 4½	.....	.....	<i>Per cent.</i>
Marion.....	40,000	.....	4½	.....	.....	.....
Richland.....	75,000	.....	5½	.....	.....	.....
Total.....	165,000	.....	.....	.....	.....	.....

SOUTH DAKOTA.

Counties.	Township.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Pennington ¹.....	.....	\$44,000	1-10	<i>Per ct.</i> 5	.....	.....	<i>Per ct.</i>
Stanley.....	Ashcreek.....	13,500	.....	.....	.....	.....	.....
		3,500	5	5	.....	.....	.....
Total.....	.....	61,000	.....	.....	.....	.....	.....

TENNESSEE.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Benton.....	.....	.....	<i>Per cent.</i>	\$200,000	.....	<i>Per cent.</i>
Bradley.....	.....	.....	.....	25,000	25-30	5
Campbell ¹.....	.....	.....	.....	4,000	1	.....
Carter.....	812,944	.....	.....	.....	.....	.....
Dickson.....	.....	.....	.....	250,000	30	5
Greene: 25 districts.....	.....	.....	.....	500,000	30	5
Hamblen.....	25,000	40	5	.....	.....	.....
Hickman ¹.....	.....	.....	.....	17,500	12½	5½
Jackson.....	.....	.....	.....	100,000	30	5
Jefferson.....	.....	.....	.....	150,000	30	.....
Loudon.....	100,000	.....	.....	150,000	30	5
Montgomery.....	.....	.....	.....	120,000	30	5
Perry.....	.....	.....	.....	14,500	7	5
Polk.....	.....	.....	.....	330,000	30	5-6
Roane.....	.....	.....	.....	110,000	30	5
Sevier: 17 districts.....	.....	.....	.....	185,000	.....	.....
Shelby.....	.....	.....	.....	600,000	12	5
Sullivan.....	200,000	20-30	4½	30,000	.....	.....
Sumner.....	200,000	30	4½	.....	.....	.....
Wayne.....	1,200	.....	.....	.....	.....	.....
White.....	90,000	.....	.....	.....	.....	.....
Total.....	629,144	.....	.....	2,786,000	.....	.....

¹ Bridge bonds only.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

TEXAS.

Counties ¹ and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Anderson.....	\$150,000	20	<i>Per cent.</i> 5			<i>Per cent.</i>
Atascosa.....				\$20,000		
Austin: Districts 1-3.....	200,000	5-40	5			
Bastrop: Districts 1-2.....	100,000	20-40	5	80,000		
Baylor.....	100,000					
Bee.....	15,000	20	5			
Bell.....	7,960			3,980		
District 1.....				200,000	40	5½
Bexar.....				750,000	40	5
Bosque: District 7.....	40,000	40				
Brazoria: District 3.....	150,000	34	5½			
Brooks.....	45,000	40	5			
Calhoun.....				5,000	40	5
Districts 1 and 2.....	100,000	40	5	135,000		
Cameron.....				20,000		
Cass: District 7.....				35,000	40	5
Chambers.....	14,000					
District 1.....	6,000	20	5			
District 4.....				100,000		
Collin.....				450,000		
Comal.....				275,000	40	5
Cooke.....	1,190					
Crockett.....				40,000	40	5
Culberson.....				50,000	40	5
Dallas.....	5,000					
Denton: District 1.....	75,000	40	5			
Ellis.....	173,000					
El Paso.....	17,000			350,000		
Fort Bend.....	30,000			175,000		
Frio.....	1,990			80,000	40	5
Galveston.....				250,000	40	5
Garza.....				50,000	40	4
Gonzales: District 1.....	150,000		5			
Grayson.....				35,000		
Districts 1 and 2.....	400,000	40	5			
Gregg.....				50,000		
Grimes.....	125,000					
Guadalupe.....				1,600		
Harris: Districts 5 and 6.....	212,000	(²)	5			
Hill: Precinct 1.....				250,000	40	5
Houston: Districts 1 and 3.....	174,000					
Howard.....	100,000					
Irion.....				20,000	40	5½
Jim Wells.....				125,000	10	5
Johnson.....				75,000		
Jones.....				3,000	20	5
Kerr.....	20,000	5-40	5	40,000		
Kinney.....				80,000		
Lamar: Precinct 1.....				100,000	10-40	5
Leon.....						
Districts 1-6.....	84,000					
District 7.....				50,000		
Liberty.....	225,000			200,000		
Limestone.....				150,000		
District 4.....	150,000	10-40	5			
Matagorda: Districts 1, 2, and 4.....				460,000		
McLennan: District 1.....	100,000	40	5			
Medina: District 4.....				40,000	40	5
Midland.....				50,000		
Milam: Districts 2 and 5.....				200,000	40	
Montgomery: District 1.....				100,000	40	5
Navarro: Districts 1 and 3.....				475,000	40	5
Nolan.....	15,000					
Nueces.....				165,000		
Orange.....	200,000					
Polk.....				40,000	4	5
Refugio.....	25,000			25,000		
Robertson.....	500,000	40	5			
Districts 1, 2, and 5.....				250,000		
San Saba.....				1,990		
Smith.....				376,250	40	5
Somervell: District 1.....	16,900					

¹ Counties subdivided into districts and precincts.² Issued by commissioner's court.³ Serial.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

TEXAS—Continued.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			<i>Per cent.</i>			<i>Per cent.</i>
Sterling.....				\$10,000		
Tarrant.....	\$1,600,000					
Tom Green ¹				70,000	10-40	5
Trinity: District 1.....				120,000	40	5
Walker.....				150,000		
Waller: Waller.....				15,000	40	5
Wharton: District 1.....	300,000	(²)	5			
Wood.....	120,000					
Zavalla.....				³ 1,999	40	5
Total.....	5,748,040			6,598,819		

UTAH.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			<i>Per cent.</i>			<i>Per cent.</i>
Boxelder.....	\$175,000	20	4½			
Grand ¹	8,500	20	5			
San Juan.....				\$14,500	20	
Total.....	183,500			14,500		

VERMONT.

Counties.	Towns.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				<i>Per ct.</i>			<i>Per ct.</i>
Addison.....	Middlebury.....				\$1,500		
Bennington.....	Bennington Center.....				10,000	13	5
Franklin.....	Berkshire.....				771		
	Sheldon.....				1,050		
Total.....					13,321		

VIRGINIA.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			<i>Per cent.</i>			<i>Per cent.</i>
Accomac:						
Atlantic.....	\$50,000		5			
Lee.....				\$50,000		5½
Augusta: South River.....	250,000	30	5			
Brunswick.....	84,000		5			
Culpeper: Catalpa.....	120,000	(²)	5			

¹ Bridge bonds only.² Serial.³ Issued by commissioner's court as emergency bonds.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

VIRGINIA—Continued.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			<i>Per ct.</i>			<i>Per ct.</i>
Dickenson: Clintwood and Kenady...	\$54,000	2-30	5	\$32,000		
Fairfax: Mount Vernon.....				90,000		
King George.....				10,000		
Lee.....				76,000		5
Lunenburg: 3 districts.....	40,000		6	64,000		5½
Nelson.....				35,000	32	5
Northampton:						
Eastville.....	50,000					
Franktown.....	20,000	30	4½			
Orange.....	125,000	10-20	5			
Pittsylvania: Dan River.....	100,000	34	5			
Pulaski: Dublin.....	100,000	10-30	5			
Rappahannock.....				64,000		5
Rockingham: Plains.....	30,000	10	6			
Russell.....				150,000		5
Scott:						
Estillville.....				100,000	20-30	5
Fulkerson.....				33,800	20-30	5
Johnson.....				33,300	20-30	5
Smyth: Marion and St. Clair.....				225,000		5
Spotsylvania: Berkeley and Livingstone.....				100,000	30	5
Stafford.....	100,000					
Warren.....				60,000		5
Westmoreland.....				25,000		5
Wise.....				260,000	30	5
Total.....	1,123,000			1,408,100		

WASHINGTON.

Asotin.....				\$35,000		
Challam.....	\$300,000	20	5			
Clarke ¹				500,000		
King.....	3,000,000	20	5			
Okanogan: District 1.....	15,000	10	10			
Snohomish: Delta.....				75,000		
Total.....	3,315,000			610,000		

WEST VIRGINIA.

Hancock:						
Butler.....	\$125,000	34	5			
Baxter and Grant.....	125,000	10-34	5			
Logan ¹				\$60,000	20	5
Marion:						
Fairmont.....				400,000	30	5
Mannington.....				300,000	30	5
Marshall.....	150,000	34	5			
Pleasants: St. Marys.....				60,000	30	5
Wetzel: Grant.....				150,000	34	6
Wood: Parkersburg.....	180,000	30	4½			
Total.....	580,000			970,000		

¹ Bridge bonds only.

TABLE 24.—County, district, and township highway and bridge bonds voted during 1912 and 1913—Continued.

WISCONSIN.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
Ashland.....		\$25,000	20	<i>Per ct.</i>	\$25,000	20	<i>Per ct.</i>
Columbia.....		20,000	20				
Iron.....		35,000	6	4			
La Crosse.....	Onalaska.....				11,000	10	5
Sauk ¹					24,000	20	4½
Vilas.....		60,000	20	5			
Total.....		140,000			60,000		

¹ Bridge bonds only.

TABLE 25.—Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds.

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.					Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.	
Alabama.....	Autauga.....	\$65,000	100				100	Includes 16 miles graded.
	Bullock.....	160,000	95	5			100	
	Dallas.....	410,000	44	137			197	
	Elmore.....	170,000	55	56			111	About 1 mile of bituminous concrete pavement; 5 miles of chert gravel and 36 additional miles in course of construction.
	Jackson.....	250,000		32	76		108	
	Marshall.....	130,000	35	30	10		75	
	Mobile.....	500,000					42	
	Morgan.....	240,000	4	1	60		65	
	Pike.....	192,000	230				230	
	Russell.....	100,000	63.5	1.5			65	
	St. Clair.....	85,000		85			85	
Arizona.....	Yuma.....	500,000		150	50		200	23 miles of graded road.
Arkansas.....	Woodruff: District 1.	30,000		6			29	
California.....	Glenn.....	450,000		160			160	118 miles graded.
	Kern.....	2,500,000		38.1	183.4		339.5	
	Los Angeles.....	3,500,000				248	248	
	Orange.....	1,370,000				107	107	
	Sacramento.....	600,000				104	104	
	San Diego.....	1,250,000					450	
	San Mateo.....	1,298,000		20	48		112	
Delaware.....	New Castle.....	1,285,000	60	2.9	161.66	2.06	226.62	Mostly surfaced with disintegrated granite; 44 miles concrete. 44 miles not specified. Of this amount \$275,000 was used for bridges.
Florida.....	Columbia.....	40,000	86				86	Brick.
	Hillsborough.....	1,400,000					70	
	Manatee.....	250,000			64		64	
	Nassau.....	60,000					22	
	Orange.....	800,000					80	
	Pasco.....	150,000			30		30	
	St. Lucie.....	200,000					50	

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds—Continued.*

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.				Total.	Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.		
Georgia.....	Ben Hill.....	\$75,000	125				125	
Idaho.....	Fremont: District 1.	120,000		60			60	
Indiana.....	Adams.....	151,550			36.9		36.9	
	Allen.....	53,840			10.34		10.34	
	Boone.....	223,260		104.5			105	$\frac{1}{2}$ mile of brick road.
	Cass: Districts 1-3.	112,425		12	15	8	35	
	Daviess.....	90,000		27	3		30	
	Delaware.....	100,000		20	10		30	
	Gibson.....	77,300			20		20	
	Hancock.....	273,500		76.5	.5		77	Bridge bonds, \$25,000.
	Henry.....	44,269		21.5		5	26.5	
	Jay.....	50,370		6.5	9		15.5	
	Martin.....	189,881		84.54			84.54	
	Miami.....	636,656		204.38	9.65		214.03	
	Morgan.....	341,200		273	75		348.75	$\frac{3}{4}$ mile of brick road.
	Union.....	60,000		14	6		20	
	Vanderburg.....	266,196			60		60	
Kansas.....	Johnson.....	61,269			13		13	
Kentucky.....	Lewis.....	6,200		5			5	
	Ohio.....	30,000			10		10	
Louisiana.....	Assumption.....	86,000		46			46	
	De Soto.....	60,000	71				71	
	East Baton Rouge.	22,000		15			15	
	Iberville: Districts 1, 5, and 6.	14,329		10.5			10.5	
Maryland.....	Cecil.....	100,000			3	14	17	
Michigan.....	Prince Georges..	16,000		10			10	
	Alpena.....	100,000		40			40	
	Baraga.....	40,000	20	10			30	
	Berrien.....	500,000			100		100	
	Genesee.....	700,000		141	14		155	
	Mackinac.....	100,000		35			35	
	Mason.....	100,000		32	3		35	
	Midland.....	56,000		10	5		15	
	Ontonagon.....	38,000		6	6		12	
	Wayne.....	2,000,000					83.5	Includes 80 miles of concrete; rest not specified.
Minnesota.....	Wexford.....	50,000		6	4		10	
	Lake.....	20,000	20				20	
	St. Louis.....	300,000		175			175	
Mississippi.....	Jackson.....	160,000	75				125	25 miles of clay and 25 miles of shell.
Missouri.....	Jasper.....	25,000	40				40	
	Lauderdale.....	350,000	32.25		51.75		84	
	Neshoba.....	100,000			28		28	
	Prentiss: Beat 1.	40,000		25			25	
	Yalobusha.....	62,000	150				150	
	Beats 2 and 4..	48,000	110				110	
	Callaway.....	100,000		16	12		28	
	Lafayette.....	125,000			14		14	
	Lawrence: Mount Vernon	50,000			12		12	
	Pettis.....	200,000		15	45		60	
Montana.....	Lewis and Clark	105,000		20			20	
	Lincoln.....	125,000		40			40	
Nevada.....	Churchill.....	23,000	15				15	
	Ormsby.....	40,000	7		7		14	
New Jersey.....	Atlantic.....	307,000		6			19	13 miles of concrete road.
New Mexico.....	Cumberland.....	43,000		20.36			20.36	
	Essex.....	1,140,505			158		158	
	Morris.....	400,000			85		85	
	Sussex.....	154,100			26		26	
	Dona Ana.....	100,000		40			40	

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds—Continued.*

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.					Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.	
New York.....	Franklin.....	\$500,000	124	Gravel and macadam.
North Carolina.	Alamance.....	200,000	45	45	Also 10 steel bridges.
	Cabarrus.....	145,000	.....	15	12	6	33
	Cumberland.....	40,000	50	.....	.....	.....	50
	Edgecombe: Districts 1-5, 8-11.	200,000	450	.....	.....	.....	450
	Gaston.....	300,000	10	.....	90	.....	100
	Guilford.....	300,000	.....	15	105	.....	120
	Haywood.....	60,000	1	2	30	.....	33
	Lee.....	100,000	8	84	.....	.....	92
Ohio.....	Vance.....	218,000	200	200	Of this amount \$9,000 was used for bridges. 3 miles of brick. 2 miles of brick. 1.5 miles of brick. 5 miles of concrete and 33.5 miles of brick. Glutrin 2.6 miles and brick 4.6 miles. Concrete 1½ miles. Brick, 1.25 miles. Concrete, 6 miles. Concrete, 2 miles. Bridge, \$85,000.
	Fayette.....	909,000	.....	421	4	.....	425
	Franklin.....	513,260	.....	.....	32	30	65
	Geauga.....	20,000	.....	.....	.....	.....	2
	Hancock.....	408,000	.....	2	100	.....	102
	Highland.....	7,850	.....	1.2	1.2	.....	2.4
	Hocking.....	50,000	.....	2.5	3	.....	7
	Licking.....	701,000	.....	.....	95	.....	133.5
	Mahoning: District 1.	150,000	.....	.....	7.1	.....	14.3
	Mercer.....	2,134,600	.....	454	135	.....	590.83
	Montgomery.....	477,000	.....	15	55	1	71
	Morgan.....	40,000	.....	.....	3.5	.....	4.75
	Noble.....	48,000	.....	.....	.....	.....	6
	Preble.....	11,160	.....	.....	2	.....	2
	Trumbull.....	755,000	.....	10	116	.....	128
Oregon.....	Jackson.....	500,000	.....	.....	.....	52	52
Pennsylvania..	Allegheny.....	15,900,000	.....	.....	604.78	134.1	836.36
South Carolina.	Carbon.....	50,000	10	10	Concrete bridge, \$17,500.
	Dillon.....	100,000	70	.....	.....	.....	70
Tennessee.....	Campbell: Districts 1-5.	200,000	32	35	67	
	Dickson.....	250,000	.....	100	.....	.....	100
Texas.....	Hamblen.....	325,000	100	100	
	Polk.....	405,000	.....	110	15	.....	125
	Baylor.....	100,000	83	.....	.....	.....	83
	Bell: 2 districts.	200,000	.....	90	.....	.....	90
	Bexar.....	1,250,000	11	230	.....	.....	241
	Bosque: District 7.	40,000	.....	10	.....	.....	10
	Brown: District 1.	150,000	35	60	.....	.....	95
	Comal.....	153,000	.....	50	.....	.....	50
	Cooke: District 1.	100,000	.....	28	.....	.....	28
	El Paso.....	617,000	10	3	.....	55	68
	Freestone: District 1.	50,000	41	.....	.....	.....	41
	Gonzales: District 1.	150,000	35	40	.....	.....	75
	Hall.....	65,000	.....	15	.....	5	20
	Hays: District 1.	87,000	6	30	9	.....	45
	Hill: Precinct 1.	250,000	.....	80	.....	.....	80
	Jackson.....	124,500	200	.....	.....	.....	200
	Jefferson.....	809,500	.....	.....	100	.....	100

¹Includes 68.1 miles of bituminous-gravel road.

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds—Continued.*

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.				Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	
Texas.....	Jim Wells.....	\$125,000	.....	100	.....	.....	100
	Leon: Districts 1, 2, 4, 5, 6.	84,000	77	.....	.....	.....	77
	McCulloch.....	118,000	41.5	27.5	.....	.....	69
	McLennan.....	150,000	.....	64	.....	.....	64
	Mitchell: District 1.	30,000	27	.....	.....	.....	27
	Smith.....	405,000	300	2	.....	.....	300
	Stonewall.....	50,000	40	.....	.....	.....	40
	Taylor: District 1.	150,000	.....	35	5	.....	40
	Waller.....	25,000	23	2	.....	.....	25
	Williamson.....	300,000	.....	150	.....	.....	150
Virginia.....	Amherst.....	215,000	.....	1.5	30.5	.....	32
	Culpeper: Cataulpa.	120,000	.....	.....	30	.....	30
	Dickenson: Clintwood.....	54,000	7	.....	7	.....	14
	Kenady.....	32,000	.....	16	.....	.....	16
	Dinwiddie.....	105,000	.....	125	.....	.....	125
	Lee.....	440,000	.....	.....	36	.....	84
	Montgomery.....	30,000	.....	.....	8	.....	8
	Nelson.....	35,000	.....	.....	7	.....	7
	Norfolk.....	200,000	.....	.....	30	.....	30
	Orange.....	175,000	.....	.....	30	.....	30
	Rappahannock: Wakefield.	30,000	.....	.....	7.5	.....	7.5
	Rockingham: Plains.	30,000	.....	.....	5	.....	5
	Spotsylvania....	100,000	.....	41.8	.....	.....	41.8
	Warren: District 2.	60,000	.....	14	1	.....	15
	Wise.....	960,000	.....	.....	48.2	.....	131
West Virginia..	Marion: Fairmont.....	400,000	.....	.....	.....	.....	22
	Mannington....	300,000	.....	.....	.....	.....	19
Wisconsin.....	Florence.....	38,000	13.18	1.84	7.78	.....	22.8
	Vilas.....	60,000	30	.....	.....	.....	30
Total.....		63,932,720	3,006.43	5,030.62	3,497.76	771.16	13,825.28

¹ In this total there are included the following:

	Miles.
Bituminous concrete pavement.....	1
Concrete (exclusive of West Virginia).....	152.45
Chert gravel (36 miles of this in course of construction).....	41
Brick (exclusive of West Virginia).....	256.96
Rock.....	25
Shell.....	57
Disintegrated granite surfaced.....	406
Clay.....	25
Marl.....	15
Glutrin.....	2.6
Plank.....	22
Graded road.....	287.8
Road not specified.....	62.5

Total (exclusive of West Virginia)..... 1,354.31

TABLE 26.—*Townships and towns*¹ giving complete mileage returns of roads built from proceeds of bonds.

State.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.				
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.
Illinois.....	Carroll: Wysox.....	\$38,500	.....	.....	15	.....	15
	Lee: Ashton.....	44,000	.....	.....	12	.....	12
Indiana.....	Bartholomew:						
	Flat Rock.....	55,500	.....	18.5	.....	.....	18.5
	Wayne.....	35,240	.....	17	.....	.....	17
	Clay: Sugar Ridge.....	545,726	.....	343	.....	.....	343
	Daviess:						
	Reeve.....	21,000	.....	5	.....	.....	5
	Washington.....	913,988	.....	295.62	.....	.....	295.62
	Gibson:						
	Center.....	48,460	.....	.....	13	.....	13
	Johnson.....	69,600	.....	.....	16	.....	16
	Montgomery.....	171,620	.....	.....	41	.....	41
	Wabash.....	21,000	.....	6.5	.....	.....	6.5
	White River.....	85,830	.....	.....	22	.....	22
	Hamilton:						
	Fallcreek.....	25,931	.....	20	.....	.....	20
	Washington.....	65,691	.....	35	.....	.....	35
	White River.....	86,985	.....	50	.....	.....	50
	Henry: Franklin.....	14,000	.....	6	.....	.....	6
	Huntington: Jackson.....	32,425	.....	8	3	.....	11
	Knox: Vincennes.....	189,360	.....	90	.....	.....	90
	Madison: Fall Creek.....	6,247	.....	2.5	.....	.....	2.5
	Marshall: Bourbon.....	28,500	.....	.....	8.5	.....	8.5
	Shelby: Shelby.....	126,097	.....	33.5	.....	.....	33.5
	Wayne:						
	Franklin and New Garden.....	7,180	.....	2	.....	.....	2
	Green.....	12,000	.....	.....	2.5	.....	2.5
Massachusetts..	Franklin: Gill.....	4,500	.....	2.5	.....	.....	2.5
Michigan.....	Baraga: Covington.....	18,000	.....	8	2	.....	10
	Berrien: Lincoln.....	20,000	.....	2.5	3	.....	5.5
	Clare: Redding.....	3,000	.....	2	.....	.....	2
	Delta:						
	Ford River.....	3,000	.....	.....	1	.....	1
	Wells.....	10,000	.....	.....	3.5	.....	3.5
	Gogebic: Marenisco.....	20,000	.....	8	.....	.....	8
	Lake: Ellworth.....	6,000	.....	3	.....	.....	3
	Monroe: Bedford.....	39,000	.....	.....	11	.....	11
	Oceana: Hart.....	44,250	.....	.....	7.85	.....	7.85
	Osceola: Osceola.....	25,000	2	3.75	.....	.....	2
	Schoolcraft: Mueller.....	6,000	6	.....	.....	.....	6
	Wexford: Henderson.....	2,000	.....	1	.....	.....	1
Minnesota.....	Cook:						
	Colvill.....	12,000	15	.....	.....	.....	15
	Maple Hill.....	15,000	10	2	.....	.....	12
	Itasca:						
	Balsom.....	20,000	17	.....	.....	.....	17
	Marcell.....	10,000	5	3	.....	.....	8
	Trout Lake.....	8,500	10	.....	.....	.....	10
	Roseau: Spruce.....	5,000	2	2	.....	.....	4
New Jersey.....	Burlington: Pemberton.....	10,000	.....	3	.....	.....	3
	Cape May: Lower.....	5,000	.....	3	.....	.....	3
New York.....	Chemung: Big Flats.....	40,645	.....	.....	8	.....	8
	Fulton: Caroga.....	35,000	.....	.5	4.5	2	7
	Westchester:						
	Scarsdale.....	147,350	.....	.....	13	7	20
	White Plains.....	218,000	.....	.....	17	6	23
Ohio.....	Ashland: Montgomery.....	98,000	.....	33	.....	.....	33
	Belmont: York.....	32,000	.....	.....	5	.....	5
	Crawford: Whetstone.....	250,000	.....	130	.....	.....	130
	Huron:						
	Norwich.....	46,000	.....	.....	10.75	.....	10.75
	Sherman.....	40,000	.....	.....	10.25	.....	10.25
	Lorain: Columbia.....	24,000	.....	.....	6	.....	6
	Mahoning:						
	Poland.....	115,000	.....	.....	.....	.....	³ 12.5
	Smith.....	100,000	.....	.....	.....	.....	³ 5
	Springfield.....	90,000	.....	.....	1	.....	⁴ 7.33
	Medina: Medina.....	127,500	41	.....	14	.....	55
	Ottawa: Catawba.....	20,000	5	4	.....	.....	9

¹ In New York and the New England States the town is synonymous with township.² Concrete road, 2.25 miles.³ Brick roads.⁴ Brick road, 6.33 miles.

TABLE 26.—*Townships and towns giving complete mileage returns of roads built from proceeds of bonds—Continued.*

State.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.				
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.
Ohio (contd.)	Richland: Weller.....	\$42,000	.....	.....	9	.....	9
	Seneca: Bloom.....	72,500	.....	.....	.....	.....	14
	Trumbull: Liberty.....	100,000	.....	.....	.....	.....	19
Pennsylvania...	Montgomery:						
	Horsham.....	25,000	.....	.....	6.5	.....	6.5
	Worcester.....	22,500	.....	.....	5	.....	5
	Warren: South West.....	20,000	4	.....	2	.....	6
Wisconsin.....	La Crosse: Onalaska.....	11,000	.....	10	.....	.....	10
	Sauk: Delton.....	16,000	.....	.....	4	.....	4
	Total.....	4,623,625	117	1,153.87	277.35	15	² 1,602.30

¹ Brick roads.² In this total there are included 2.25 miles of concrete road and 36.83 miles of brick road; total, 39.08 miles.TABLE 27.—*Summary of all highway and bridge bonds voted to Jan. 1, 1914.*

State.	State bonds.	County and district bonds.	Township bonds.
Alabama.....		\$5,121,500	.....
Arizona.....		808,000	.....
Arkansas.....		1,218,315	.....
California.....	\$18,000,000	15,630,800	.....
Colorado.....		134,700	.....
Connecticut.....	10,500,000		8576,500
Delaware.....		1,395,000	.....
Florida.....		7,285,000	.....
Georgia.....		1,176,000	.....
Idaho.....	505,000	1,221,837	.....
Illinois.....		420,320	1,618,634
Indiana.....		18,072,049	35,837,348
Iowa.....		4,006,314	.....
Kansas.....		1,132,375	677,065
Kentucky.....		1,759,872	.....
Louisiana.....		1,932,840	.....
Maine.....	2,000,000		78,000
Maryland.....	9,170,000	750,500	.....
Massachusetts.....	14,365,000	813,000	650,473
Michigan.....		6,382,152	1,926,135
Minnesota.....		1,388,350	982,805
Mississippi.....		8,710,872	.....
Missouri.....		1,721,500	65,000
Montana.....		2,239,606	.....
Nebraska.....		553,500	246,170
Nevada.....		175,000	.....
New Hampshire.....	1,300,000		40,000
New Jersey.....		14,386,782	760,600
New Mexico.....	500,000	246,500	.....
New York.....	100,000,000	9,097,923	2,631,165
North Carolina.....		5,541,273	2,751,300
North Dakota.....		63,000	.....
Ohio.....		35,241,828	5,283,805
Oklahoma.....		1,440,000	382,288
Oregon.....		2,150,000	.....
Pennsylvania.....		24,839,050	2,333,609
Rhode Island.....	1,800,000		265,000
South Carolina.....		410,000	.....
South Dakota.....		77,300	3,500
Tennessee.....		12,674,298	.....
Texas.....		24,960,837	.....
Utah.....	260,000	440,500	.....
Vermont.....			17,321
Virginia.....		6,632,400	.....
Washington.....	190,000	4,408,262	.....
West Virginia.....		2,500,000	.....
Wisconsin.....		244,000	27,000
Total.....	158,590,000	229,403,355	57,153,718

APPENDIX C.

TABLE SHOWING COST ELEMENTS OF GRAVEL, MACADAM, AND BITUMINOUS
MACADAM ROADS IN MAINE, MASSACHUSETTS, AND NEW JERSEY.

TABLE 28.¹—Table showing cost elements of gravel roads for years 1908–1911.

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 20-foot width.		
					Drainage and grad- ing.	Surfac- ing.	Drain- age and grad- ing.	Surfac- ing.	Total.
1908.									
1	Camden, Me.....	1,400	26	\$1,795.07	69.40	30.62	\$3,612	\$1,596	\$5,208
2	Eastport, Me.....	1,900	25	1,634.00	50.00	50.00	1,816	1,816	3,632
3	Lisbon, Me.....	1,800	24	1,703.63	52.53	47.40	2,189	1,975	4,164
4	Presque Isle, Me.....	1,115	40	1,526.95	46.35	53.50	1,676	1,937	3,614
5	Richmond, Me.....	775	36	1,066.91	53.90	46.10	2,165	1,858	4,023
6	Rockland, Me.....	1,250	20	2,382.17	70.30	29.80	7,078	2,987	10,065
7	May's Landing, N. J.....	73,603	16	37,416.42	34.38	65.62	1,153	2,201	3,355
8	Red Lion, N. J.....	19,272	12	12,607.26	36.64	63.36	2,108	3,648	5,756
9	Tuckahoe, N. J.....	17,946	14	25,558.10	54.96	45.04	5,945	4,834	10,780
10	Malaga, N. J.....	30,307	24	14,040.13	29.46	70.54	600	1,436	2,037
11	Half Acre, N. J.....	17,793	20	9,961.89	63.89	36.11	1,887	1,068	2,955
12	Farmingdale, N. J.....	15,840	20	9,232.61	34.78	63.06	1,070	1,940	3,010
13	Eatontown (1st), N. J.....	17,160	14	32,439.77	14.01	86.12	1,980	12,285	14,265
14	Bayhead, N. J.....	24,662	24	25,950.75	36.63	63.34	1,695	2,950	4,645
15	Lakehurst, N. J.....	33,448	24	22,955.98	55.57	44.51	1,677	1,343	3,020
16	Aldine, N. J.....	7,001	20	11,110.11	56.71	43.28	4,752	3,625	8,377
1909.									
17	Fairfield, Me.....	1,819	15	1,165.35	74.11	25.87	3,353	1,166	4,520
18	Falmouth, Me.....	1,541	21	1,021.12	85.51	14.48	2,842	480	3,323
19	Jay, Me.....	1,100	15	1,386.71	77.06	22.94	6,833	2,038	8,872
20	Presque Isle, Me.....	1,100	40	1,500.45	56.27	44.39	2,039	1,600	3,639
21	Rockland, Me.....	1,600	23	2,366.01	62.00	38.39	4,201	2,603	6,805
22	Sanford, Me.....	2,425	22	2,773.71	55.22	44.89	3,017	2,454	5,471
23	English Creek, N. J.....	35,481	20	15,061.12	38.94	61.05	873	1,368	2,241
24	Chestnut Neck, N. J.....	2,745	27.5	5,697.15	85.44	14.58	6,805	1,161	7,967
25	Schellenger's Landing, N. J.....	11,066	20	12,258.99	54.37	45.62	3,225	2,670	5,895
26	Goshen, N. J.....	13,743	20	10,688.66	35.40	64.69	1,451	2,655	4,106
27	Tuckahoe, N. J.....	22,513	20	24,544.00	53.10	46.91	3,055	2,700	5,755
28	Rio Grande, N. J.....	15,348	20	14,556.54	34.17	65.83	1,711	3,300	5,011
29	Cranbury, N. J.....	12,994	20	5,912.88	40.37	59.63	970	1,432	2,402
30	Allentown, N. J.....	19,668	18	13,439.93	36.78	63.21	1,474	2,533	4,007
31	Lakewood, N. J.....	11,404	14	8,448.00	36.08	63.92	2,014	3,571	5,586
32	Lakewood, N. J.....	15,137	24-36	15,048.63	54.32	45.68	1,900	1,600	3,500
33	Barnsboro, N. J.....	17,476	20	12,589.80	41.15	65.99	1,565	2,510	4,075
34	Alloway, N. J.....	25,132	20	21,100.29	55.56	44.44	2,462	1,970	4,432
1910.									
35	Augusta, Me.....	3,500	21	2,727.64	13.49	46.78	529	1,833	2,362
36	Bridgton, Me.....	2,500	15	1,657.69	71.04	28.96	3,312	1,366	4,678
37	Camden, Me.....	1,300	21	1,883.25	21.56	78.48	1,569	5,714	7,283
38	Dexter, Me.....	712	21	1,239.67	42.37	57.63	3,714	5,038	8,752
39	Eastport, Me.....	2,375	18	1,128.74	56.61	43.38	1,575	1,208	2,784
40	Fairfield, Me.....	1,500	22	3,786.74	63.74	36.27	7,545	4,390	11,936
41	Gorham, Me.....	1,250	23	967.70	31.50	68.48	1,119	2,434	3,553
42	Kennebunk, Me.....	4,996	21	2,435.71	13.31	87.00	427	2,023	2,450
43	Lisbon, Me.....	1,800	24	1,053.02	37.65	62.35	970	1,605	2,575
44	Millinocket, Me.....	1,500	30	1,071.32	29.97	70.30	756	1,760	2,516
45	Milo, Me.....	1,500	21	1,018.30	36.99	63.01	1,214	2,150	3,364
46	Mount Desert, Me.....	1,030	22	1,370.47	85.22	14.78	5,456	945	6,401
47	Norway, Me.....	1,115	23	1,028.61	90.65	9.40	3,836	398	4,234
48	Orono, Me.....	1,800	25	1,043.20	68.21	31.80	1,670	779	2,449
49	Paris, Me.....	1,450	25	1,080.00	24.06	75.92	756	2,384	3,140

¹ This table was compiled from the annual reports of the State highway departments of the three States concerned. Geographical names given in New Jersey are sometimes not names of places, but of roads or streets.

TABLE 28.—Table showing cost elements of gravel roads for years 1908-1911—Contd.

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 20-foot width.		
					Drainage and grad- ing.	Surfac- ing.	Drainage and grad- ing.	Surfac- ing.	Total.
1910—Continued.									
50	Presque Isle, Me.	1,600	21	\$1,675.05	41.92	58.10	\$2,205	\$3,380	\$5,586
51	Rockland, Me.	2,000	24	2,193.74	88.16	11.84	4,245	570	4,815
52	Sanford, Me.	1,900	26	1,860.29	32.15	67.85	1,280	2,700	3,980
53	Scarboro, Me.	2,000	21	1,048.13	19.11	80.89	502	2,133	2,636
54	Waterville, Me.	1,800	29	1,803.05	24.70	75.26	901	2,743	3,644
55	Yarmouth, Me.	1,360	24	1,738.48	42.49	54.66	2,550	3,075	5,625
56	Cologne, N. J.	42,646	20	19,575.36	27.38	72.62	664	1,760	2,424
57	Deans, N. J.	14,509	20	9,773.00	34.48	65.52	1,227	2,333	3,560
58	Red Bank, N. J.	20,201	18	19,735.21	30.24	69.82	1,735	4,005	5,741
59	Farmingdale, N. J.	10,032	18	11,427.88	64.89	35.11	4,332	2,344	6,677
60	Lakewood, N. J.	13,200	14	7,381.65	43.91	56.09	1,851	2,364	4,215
61	Barnsboro, N. J.	17,476	20	8,489.80	61.02	38.98	1,564	999	2,564
1911.									
62	Allentown, N. J.	10,274	18	15,117.98	35.61	64.39	3,082	5,520	8,602
63	Red Bank, N. J.	8,184	18	17,262.78	17.54	80.96	2,592	9,994	12,586
64	Lakewood, N. J.	18,458	14	8,737.53	60.55	39.52	2,160	1,410	3,570
65	Lakewood, N. J.	5,174	14	3,579.96	50.01	49.99	2,610	2,607	5,217
66	Cedar Ave., N. J.	13,807	16, 18	22,442.25	21.70	78.30	2,190	7,731	9,921
67	Seaside Park, N. J.	28,395	24	42,347.32	35.61	64.38	2,337	4,225	6,562
68	Elmerborough, N. J.	9,387	18, 42	8,048.75	23.58	76.42	710	2,305	3,016
69	Camden, Me.	1,000	30	1,588.77	42.10	57.92	2,353	3,233	5,586
70	Dexter, Me.	1,400	26	1,105.20	40.43	59.65	1,293	1,911	3,205
71	Eastport, Me.	1,844	22	1,175.15	59.47	40.53	1,818	1,238	3,056
72	Fairfield, Me.	650	23	1,549.41	60.91	39.09	6,652	4,282	10,934
73	Farmington, Me.	1,350	23	1,225.00	52.37	47.61	2,181	1,982	4,163
74	Freeport, Me.	900	20	1,440.16	34.24	65.76	2,892	5,550	8,442
75	Gorham, Me.	2,050	23	1,220.39	42.33	57.69	1,156	1,575	2,732
76	Kennebunk, Me.	4,135	21	2,221.16	37.98	62.00	1,028	1,675	2,703
77	Lisbon, Me.	1,350	21	1,880.97	39.65	55.03	2,771	4,228	7,000
78	Millinocket, Me.	1,280	30	1,238.44	32.29	67.72	1,100	2,306	3,407
79	Norway, Me.	1,300	23	1,096.23	42.74	57.25	1,655	2,213	3,868
80	Old Orchard, Me.	1,200	21	1,019.15	43.57	56.43	1,860	2,417	4,278
81	Orono, Me.	2,316	25	1,017.03	57.86	42.17	1,648	800	2,448
82	Presque Isle, Me.	1,600	24	1,390.28	41.90	58.10	1,599	2,233	3,832
83	Princeton, Me.	1,536	24	1,148.25	88.67	11.32	2,910	371	3,281
84	Rockport, Me.	630	21	1,031.82	68.09	31.91	5,600	2,628	8,228
85	Sanford, Me.	1,800	24	1,565.99	12.93	87.09	495	3,333	3,829
86	Windham, Me.	2,000	25	940.69	63.28	35.82	1,284	712	1,996
87	Yarmouth, Me.	1,200	24	1,414.13	49.57	50.42	2,533	2,615	5,148
Total and weighted averages		143.53	20	4,417.00	41.15	58.85	1,817	2,599	4,416

¹ Miles.

TABLE 29.¹—Table showing cost elements of water-bound macadam roads for years 1908-1911.

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 15-foot width.		
					Drainage and grading.	Surfacing.	Drainage and grading.	Surfacing.	Total.
1908.									
1	Augusta, Me.	1,800	21	\$2,556.29	44.9	55.1	\$2,410	\$2,950	\$5,360
2	Biddeford, Me.	1,800	27	4,067.68	48.8	51.2	3,240	3,400	6,640
3	Brewer, Me.	1,300	47	2,198.44	26.6	73.4	760	2,080	2,840
4	Calais, Me.	2,100	21	1,787.05	26.9	73.1	860	2,340	3,200
5	Caribou, Me.	670	45	1,646.14	25.5	74.5	1,100	3,220	4,320
6	Farmington, Me.	1,000	16	1,207.99	14.8	85.2	880	5,090	5,970
7	Gardiner, Me.	1,660	21	1,978.10	22.4	77.6	1,000	3,490	4,490
8	Houlton, Me.	2,000	21	2,033.50	21.6	78.4	830	3,000	3,830
9	Jay, Me.	1,000	16	1,140.18	13.8	86.2	780	4,860	5,640
10	Saco, Me.	866	35	1,898.45	19.7	80.3	980	3,970	4,950
11	Sanford, Me.	2,400	16	2,632.04	75.6	24.4	4,100	1,320	5,420
12	Skowhegan, Me.	1,900	15	2,027.85	56.5	43.5	3,180	2,450	5,630
13	South Portland, Me.	640	20	1,356.30	20.4	79.6	1,710	6,670	8,380
14	Riverdale, N. J.	26,240	14	33,437.76	31.3	68.7	2,260	4,950	7,210
15	Westwood, N. J.	6,260	14	8,225.83	20.2	79.8	1,500	5,940	7,440
16	Franklin, N. J.	8,400	14	16,199.90	59.7	40.3	6,520	4,400	10,920
17	Summit, N. J.	9,770	14	17,352.93	41.2	58.8	4,140	5,900	10,040
18	Lumberton, N. J.	2,060	14	31,110.00	5.1	94.9	440	8,110	8,550
19	Westfield, N. J.	16,470	14	32,745.23	19.8	80.2	2,230	9,010	11,240
20	West Fairfield, N. J.	11,160	16	17,494.24	12.5	87.5	970	6,780	7,750
21	Westville, N. J.	7,750	16	11,104.20	25.0	75.0	1,780	5,330	7,110
22	Harrison Street, N. J.	6,860	16	10,549.60	30.5	69.5	2,320	5,280	7,600
23	Watchung, N. J.	4,650	16	17,074.76	63.3	36.7	11,510	6,670	18,180
24	High Street, N. J.	5,240	16	10,817.30	44.3	55.7	4,530	5,690	10,220
25	Whitehouse, N. J.	34,190	14	52,982.30	28.0	72.0	2,460	6,310	8,770
26	Etra, N. J.	6,280	14	9,329.38	18.6	81.4	1,560	6,840	8,400
27	Brunswick, N. J.	19,540	16	34,663.66	22.6	77.4	1,980	6,800	8,780
28	Colonia, N. J.	8,400	14	14,444.61	33.4	66.6	3,250	6,470	9,720
29	Cranbury, N. J.	5,300	14	7,059.80	14.6	85.4	1,100	6,430	7,530
30	Livingston Avenue, N. J.	5,910	16	10,693.87	14.0	86.0	1,250	7,690	8,940
31	Main Street, Woodbridge, N. J.	9,240	14	19,271.27	42.1	57.9	4,970	6,830	11,800
32	State St., Perth Amboy, N. J.	7,180	14	10,995.50	27.9	72.1	2,420	6,250	8,670
33	River Road "A," N. J.	8,760	14	17,157.42	33.1	66.9	3,660	7,410	11,070
34	River Road "B," N. J.	15,620	14	32,805.66	39.1	60.9	4,630	7,220	11,850
35	Jamesburg, N. J.	15,100	14	24,102.39	20.4	79.6	1,840	7,190	9,030
36	Manalapan, N. J.	1,400	14	3,616.45	17.5	82.5	2,560	12,060	14,620
37	Rumson Road, N. J.	4,010	16	9,123.39	19.4	80.6	2,180	9,070	11,250
38	Eatontown (2d), N. J.	17,480	14	25,988.28	21.1	78.9	1,780	6,640	8,420
39	Allentown, N. J.	5,040	18	10,664.37	13.1	86.9	1,220	8,090	9,310
40	Midvale, N. J.	16,530	16	43,422.05	71.9	28.1	9,350	3,660	13,010
41	Macopin, N. J.	9,820	14	20,544.09	66.1	33.9	7,820	4,010	11,830
42	South Bound Brook, N. J.	11,880	14	21,113.73	41.2	58.8	4,140	5,910	10,050
43	Dead River, N. J.	11,190	14	18,589.99	29.5	70.5	2,770	6,620	9,390
44	North Broad Street, N. J.	5,050	16	15,801.63	30.1	69.9	4,670	10,830	15,500
45	Terrill Road, N. J.	5,300	16	8,054.08	28.9	71.1	2,170	5,350	7,520
1909.									
46	Brewer, Me.	1,575	24	1,486.75	12.7	87.3	390	2,720	3,110
47	Calais, Me.	2,100	21	1,811.65	20.4	79.6	660	2,590	3,250
48	Camden, Me.	750	30	1,712.52	50.9	49.1	3,070	2,960	6,030
49	Caribou, Me.	533	37	1,106.00	13.6	86.4	610	3,840	4,450
50	Dexter, Me.	675	19	1,009.30	55.3	44.7	3,430	2,780	6,210
51	Eden, Me.	1,100	24	3,012.18	50.7	49.3	4,580	4,450	9,030
52	Gardiner, Me.	1,200	21	3,035.32	26.3	73.7	2,510	7,030	9,540
53	Houlton, Me.	1,500	21	2,499.73	50.5	49.5	3,170	3,100	6,270
54	Rumford, Me.	6,831	20	7,364.80	32.5	67.5	1,380	2,880	4,260
55	Saco, Me.	775	35	2,060.80	14.6	85.4	880	5,150	6,030
56	Skowhegan, Me.	1,550	15	2,134.85	48.2	51.8	3,500	3,700	7,200
57	South Portland, Me.	525	25	1,420.34	13.7	86.3	1,190	7,370	8,560
58	Waterville, Me.	1,300	40	2,726.40	8.5	91.5	350	3,800	4,150
59	Yesler Way, N. J.	14,020	14	18,850.72	32.9	67.1	2,500	5,100	7,600
60	Valley Road, N. J.	16,530	14	15,409.85	25.4	74.6	1,340	3,940	5,280
61	Bridge Street, N. J.	700	16	2,374.79	36.5	63.5	6,140	10,720	16,860
62	Whitehouse, N. J.	30,980	14	42,934.46	41.0	59.0	3,210	4,630	7,840
63	North Crosswicks, N. J.	1,160	16	2,354.95	11.0	89.0	1,100	8,930	10,030
64	Cheesekakes Creek, N. J.	10,400	14	33,366.90	57.0	43.0	10,340	7,810	18,150
65	Jamesburg, N. J.	6,970	14	10,782.65	9.9	90.1	860	7,890	8,750

¹ See footnote 1, Table 28, p. 86.

TABLE 29.¹—Table showing cost elements of water-bound macadam roads for years 1908-1911—Continued.

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equiva- lent 15-foot width.		
					Drain- age and grad- ing.	Surfac- ing.	Drain- age and grad- ing.	Surfac- ing.	Total.
1909—Continued.									
66	Keyport, N. J.	6,340	16	\$16,850.21	53.7	46.3	\$7,070	\$6,100	\$13,170
67	Penn's Grove, N. J.	15,950	16	26,599.42	20.5	79.5	1,690	6,560	8,250
68	Terrill (1), N. J.	620	14	1,014.17	21.8	78.2	2,010	7,200	9,210
69	Green Brook, N. J.	6,120	14	12,469.55	43.8	56.2	5,050	6,470	11,520
70	Washington Valley, N. J.	10,940	14	26,714.22	60.4	39.6	8,510	5,570	14,080
71	Frankford, N. J.	18,240	14	34,747.92	47.7	52.3	5,140	5,640	10,780
72	Morris, N. J.	6,180	16	11,210.09	50.1	49.9	4,500	4,480	8,980
73	New Brunswick, N. J.	3,960	16	10,246.74	46.7	53.3	5,980	6,830	12,810
1910.									
74	Augusta, Me.	585	21	831.12	4.4	95.6	240	5,110	5,350
75	Bath, Me.	1,680	20	2,370.50	31.5	68.5	1,760	3,830	5,590
76	Biddeford, Me.	1,324	21	2,625.50	18.9	81.1	1,410	6,070	7,480
77	Brewer, Me.	1,500	40	1,996.84	39.9	60.1	1,050	1,590	2,640
78	Calais, Me.	1,400	21	1,625.53	39.9	60.1	1,740	2,630	4,370
79	Caribou, Me.	1,773	27	2,234.00	44.9	55.1	3,810	4,670	8,480
80	Dover, Me.	455	36	1,222.56	23.8	76.2	1,410	4,500	5,910
81	Fort Fairfield, Me.	832	32	1,487.00	49.7	50.3	2,200	2,220	4,420
82	Freeport, Me.	700	21	1,230.74	33.9	66.1	2,250	4,380	6,630
83	Hallowell, Me.	437	39	1,240.90	17.2	82.8	990	4,770	5,760
84	Houlton, Me.	1,400	22	2,252.00	33.4	66.6	1,930	3,850	5,780
85	Jay, Me.	1,150	21	1,235.56	19.0	81.0	770	3,280	4,050
86	Oldtown, Me.	1,005	21	1,821.93	32.6	67.4	2,230	4,600	6,830
87	Rumford, Me.	4,320	23	6,227.56	25.6	74.4	1,270	3,690	4,960
88	Berwick, Me.	800	21	1,016.94	27.0	73.0	1,300	3,500	4,800
1911.									
89	Brunswick, Me.	1,300	21	1,836.82	25.7	74.3	1,370	3,950	5,320
90	Caribou, Me.	333	46	1,406.24	30.4	69.6	2,210	5,060	7,270
91	Hallowell, Me.	500	20	1,080.00	19.2	80.8	1,640	6,910	8,550
92	Houlton, Me.	1,700	21	2,667.10	21.5	78.5	1,270	4,640	5,910
93	Oldtown, Me.	800	22	1,829.07	42.9	57.1	3,530	4,700	8,230
94	Rumford, Me.	1,125	23	2,604.47	18.5	81.5	1,480	6,500	7,980
95	Wilton, Me.	1,200	21	1,311.21	28.7	71.3	1,180	2,920	4,100
1910.									
96	Ringoes, N. J.	21,550	14	36,425.67	31.6	68.4	3,020	6,540	9,560
97	Asbury, N. J.	5,280	14	7,500.00	34.4	65.6	2,770	5,270	8,040
98	Main Street, N. J.	68,800	14	15,810.67	43.2	56.8	5,620	7,380	13,000
99	Frankford, N. J.	18,250	14	34,747.92	47.7	52.3	5,140	5,630	10,770
1911.									
100	Smalley's Corner, N. J.	16,860	15	22,759.49	24.1	75.9	1,890	5,960	7,850
101	Brunswick, N. J.	5,340	16	10,450.65	15.4	84.6	1,490	8,200	9,690
102	Yardville, N. J.	18,000	14	32,396.84	15.5	84.5	160	860	1,020
103	Greater Cross Roads, N. J.	10,470	14	20,633.71	29.6	70.4	3,300	7,850	11,150
104	Buttsville, N. J.	19,420	14	31,371.99	37.6	62.4	3,430	5,700	9,130
Total and weighted averages.....		2 137.51	15	8,688.00	36.89	63.11	3,400	5,815	9,215

¹ See footnote 1, Table 28, p. 86.² Miles.

TABLE 30.¹—Table showing cost elements of bituminous-macadam roads for 1908-1911

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 15-foot width.		
					Drain- age and grad- ing.	Surfac- ing.	Drain- age and grad- ing.	Surfac- ing.	Total.
1908.									
1	Kennebunk, Me.....	426	27	\$1,597.30	25.3	74.7	\$2,780	\$8,220	\$11,000
2	Waterville, Me. ²	760	46	3,565.18	11.5	88.5	930	7,150	8,080
1909.									
3	Camden, N. J.	12,693	14	29,043.42	28.3	71.7	3,660	9,290	12,950
4	Evesham, N. J. ³	12,838	14	22,649.61	20.8	79.2	2,080	7,910	9,990
5	Hopewell, N. J. ²	10,720	18	16,121.40	21.0	79.0	1,390	5,230	6,620
6	Trenton, N. J.	13,227	16	24,509.44	20.3	79.7	1,870	7,320	9,190
7	Helmetta, N. J.	14,271	14	21,375.59	11.3	88.7	960	7,510	8,470
8	Plainsboro, N. J.	12,992	14	21,596.57	13.7	86.3	1,290	8,100	9,390
9	Terrill, N. J.	9,982	16	26,404.08	37.2	62.8	4,870	8,230	13,100
10	Stoutsburg, N. J.	10,845	14	19,741.90	22.0	78.0	2,270	8,030	10,300
11	Edgar, N. J.	17,526	16	42,424.74	25.0	75.0	2,990	8,990	11,980
12	Washington Avenue, N. J.	6,125	16	14,230.20	23.4	76.6	2,690	8,810	11,500
13	Walnut Avenue, N. J.	6,313	16	15,868.00	19.7	80.3	2,450	9,990	12,440
1910.									
14	Belfast, Me. ⁴	580	21	1,997.53	43.7	56.3	5,670	7,310	12,980
15	Coffin's Corner, N. J.	11,866	14	25,138.87	14.8	85.2	1,780	10,220	12,000
16	Nicholson, N. J.	6,532	14	13,168.82	14.6	85.4	1,660	9,740	11,400
17	Brown's Corner, N. J.	8,601	14	20,468.00	24.3	75.7	3,270	10,180	13,450
18	Runnymede, N. J.	8,984	16	19,408.76	30.9	69.1	3,310	7,390	10,700
19	Mountain, N. J.	325	16	561.00	5.0	95.0	430	8,190	8,620
20	River Road, N. J.	6,458	16	13,705.67	13.7	86.3	1,440	9,070	10,510
21	Kingston, N. J.	3,805	14	6,555.88	17.9	82.1	1,740	8,000	9,740
22	Somerset Street, N. J.	2,040	14	4,252.27	45.5	54.5	5,380	6,440	11,820
23	Seventh Street, N. J.	8,700	14	15,213.40	14.4	85.6	1,390	8,290	9,680
24	Morris Plains, N. J.	13,718	14	33,176.53	26.9	73.1	3,680	9,990	13,670
25	Gladstone, N. J.	21,053	14	42,979.47	27.3	72.7	3,130	8,320	11,450
26	Pompton, N. J.	15,516	14	18,930.85	29.2	70.8	2,020	4,890	6,910
27	Union, N. J.	4,164	14	12,251.98	8.1	91.9	1,350	15,290	16,640
28	Warrenville, N. J.	3,600	14	8,310.13	48.8	51.2	6,370	6,690	13,060
29	Frankford, N. J.	17,309	14	25,313.87	37.6	62.4	3,110	5,170	8,280
30	Raritan, N. J.	13,013	16	40,820.75	28.1	71.9	4,360	11,170	15,530
31	Washington Avenue, N. J.	1,300	16	3,272.00	29.4	70.6	3,670	8,810	12,480
32	Beattystown, N. J.	45,341	14	73,580.20	40.1	59.9	3,680	5,500	9,180
1911.									
33	Brunswick, Me.....	640	21	1,461.37	11.2	88.8	970	7,660	8,630
34	East Livermore, Me.....	750	26	1,621.35	14.1	85.9	930	5,650	6,580
35	Saco, Me.	580	28	1,925.00	34.4	65.6	3,230	6,160	9,390
36	Chapel, N. J.	4,515	14	12,681.75	28.1	71.9	4,470	11,450	15,920
37	Railroad, N. J.	859	30	4,587.51	9.6	90.4	1,350	12,720	14,070
38	Swedesboro, N. J.	18,115	16	45,633.30	10.4	89.6	1,300	11,170	12,470
39	Rocky Hill, N. J.	4,200	14	8,744.39	35.4	64.6	4,170	7,600	11,770
40	Springfield, N. J.	8,362	16	26,965.52	23.4	76.6	3,730	12,230	15,960
41	Agawam, Mass. ²	4,720	15	9,726.00	29.3	70.7	3,188	7,692	10,880
42	Chester, Mass. ²	8,000	15	14,996.00	42.9	57.1	4,246	5,652	9,898
43	Franklin, Mass. ⁵	6,360	15	5,547.00	39.4	60.6	1,814	2,791	4,605
44	Holliston, Mass. ⁵	9,800	15	10,796.00	46.2	53.8	2,687	3,130	5,817
45	Ipswich, Mass. ⁵	4,860	15	5,683.00	34.2	65.8	2,112	4,062	6,174
46	Lakeville, Mass. ²	10,250	15	14,492.00	39.0	61.0	2,911	4,554	7,465
47	Lanesborough, Mass. ²	9,070	15	13,080.00	46.7	53.3	3,556	4,059	7,615
48	Milford, Mass. ²	6,210	15	11,804.00	50.7	49.3	5,089	4,948	10,037
49	Plainville, Mass.	2,370	15	5,033.00	37.5	62.5	3,893	6,489	10,382
50	Seekonk, Mass. ²	7,920	15	5,552.00	16.6	83.4	3,615	3,088	3,703
51	Tyngsborough, Mass.	4,250	15	8,301.00	30.5	69.5	3,145	7,167	10,312
52	Wilmington, Mass.	5,790	15	10,570.00	20.2	79.8	1,947	7,692	9,639
53	.....do.....	7,450	15	11,517.00	24.9	75.1	2,032	6,130	8,162
Total and weighted averages		6 84.63	15	10,267.00	26.85	73.15	2,765	7,533	10,298

¹ See footnote 1, Table 28, p. 86.² Bituminous surface coat.³ Bituminous pavement on 2,022 square yards.⁴ Bituminous-macadam surface 62 per cent.⁵ Five inches of gravel and a bituminous surface coat.⁶ Miles.

APPENDIX D.

THEORY OF INTEREST APPLIED TO HIGHWAY-BOND CALCULATIONS, WITH SINKING FUND, ANNUITY, AND INTEREST TABLES FOR 60 INTERVALS AND 14 RATES OF INTEREST.

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APPENDIX D.

THEORY OF INTEREST APPLIED TO BOND CALCULATIONS.

Introduction.—This appendix presents briefly the application of the theory of compound interest to highway bonds. There are six important quantities in terms of which the solution of most problems can be expressed. If i is the rate of interest and n the term of years, these quantities are:

The accumulation of 1 at the end of n years, r^n ;

The accumulation of an annuity of 1 per annum at the end of n years, $s_{\overline{n}|}$;

The annual sinking fund which will accumulate to 1 at the end of n years, $1/s_{\overline{n}|}$;

The present value of 1 due in n years, v^n ;

The present value of an annuity of 1 per annum for n years, $a_{\overline{n}|}$;
and

The annuity for n years which 1 will purchase, or the annuity necessary to discharge a debt of 1 in n years with interest, $1/a_{\overline{n}|}$.

The first three are accumulative functions and the last three are discount or present value functions.

The mathematical formulas for these six quantities are:

$$\begin{array}{lll} r^n = (1+i)^n & s_{\overline{n}|} = \frac{(1+i)^n - 1}{i} & \frac{1}{s_{\overline{n}|}} = \frac{i}{(1+i)^n - 1} \\ v^n = (1+i)^{-n} & a_{\overline{n}|} = \frac{1 - (1+i)^{-n}}{i} & \frac{1}{a_{\overline{n}|}} = \frac{i}{1 - (1+i)^{-n}} \end{array}$$

The values of most of these functions are given more or less completely in published tables of interest.¹

Definitions.—*Interest* may be defined as the consideration for the use of capital. The capital is called the *principal*.

The *rate* at which a given principal is earning interest requires the adoption of some interval as the unit of time, and this is usually the *year*.

It is clear that interest when received may be added to the principal and so in turn earn interest. This process, called *compounding*, takes place at the end of *stated intervals*, as every three months, six months, or year.

¹ At the end of this appendix, pages 116 to 127, are short tables to seven places for 60 intervals and 14 interest rates.

Mathematical rates.—The *effective rate of interest* is the interest earned by one unit of principal (one dollar) in one unit of time (one year) when interest is *compounded* at the end of each *stated interval*.

The *nominal rate of interest* is the total interest earned by one unit of principal (one dollar) in one unit of time (one year) when interest is *not compounded* at the end of each *stated interval*.

It follows that the nominal and effective rates of interest coincide only when the *stated interval* is the unit of time (one year).

Commercial rate.—In commercial transactions the rate of interest is usually quoted as a rate *per cent*, or per hundred units of principal, instead of a rate *per unit* of principal, as in the above definitions. To find the mathematical rate as above defined, divide the commercial rate by 100. For example, the mathematical rate corresponding to the commercial rate 6 per cent is $6/100$, or .06. The mathematical rate is used in the following formulas.

Relation between effective and nominal rates of interest.—In any transaction there is an effective rate of interest i and a corresponding nominal rate of interest j . This relation can be expressed by an algebraic formula which involves the number of *stated intervals*, m , in one year. At the nominal rate j , during each stated interval $1/m$ th of a year in length, one unit of principal would earn j/m in interest which, added to the unit, gives an amount $1 + j/m$. If the principal 1 accumulates in the first interval to $1 + j/m$, it follows by proportion that the principal $1 + j/m$ would accumulate in the second interval to $(1 + j/m)^2$. In like manner, at the end of the m th interval, the accumulation would be $(1 + j/m)^m$. The total interest earned in the m intervals, or one year, is the difference between the accumulation and the original unit of principal, which by definition is the *effective rate* of interest i . Hence the fundamental formula:

$$i = (1 + j/m)^m - 1 \quad (1)$$

or

$$1 + i = (1 + j/m)^m. \quad (2)$$

Solving for j , there results

$$j = m[(1 + i)^{1/m} - 1]. \quad (3)$$

The number of times, m , that interest is added, or converted into principal each year, is the *frequency of conversion*. A nominal rate of interest, convertible m times a year, is indicated by the symbol $j_{(m)}$.

Example 1.—The nominal rate of interest j on deposits is 3% and interest is added to the principal every six months; to find the effective rate i .

Here $j = .03$ and $m = 2$. From formula (1) there results

$$i = (1 + .03/2)^2 - 1 = (1.015)^2 - 1 = .030225.$$

The effective rate 3.0225% is thus slightly higher than the corresponding nominal rate convertible twice per annum.

Example 2.—The effective rate of interest is 6%; to find the corresponding nominal rate when interest is convertible semiannually.

Here i and m are given to find j ; hence from formula (3) there results

$$j=2[(1+.06)^{\frac{1}{2}}-1]=2(1.06)^{\frac{1}{2}}-2=2.059126-2=.059126.$$

It is necessary to extract the square root of 1.06. The final result shows that $j=5.9126\%$, and again the nominal rate is smaller than the corresponding effective rate.

Amount of 1 in n years at compound interest.—Let the effective rate of interest be i . At the end of the first year the accumulation is $1+i$. During the second year this principal $1+i$ will be increased in the ratio of 1 to $1+i$, and will therefore amount at the end of the second year to $(1+i)(1+i)$, or $(1+i)^2$. In this way at the end of n years the amount is $(1+i)^n$.

Let P be the principal and S the amount of P at the end of n years at compound interest at the effective rate i . Since 1 amounts to $(1+i)^n$ in n years, P would amount to $P(1+i)^n$. There results, therefore, the formula

$$S=P(1+i)^n. \quad (4)$$

Hence

$$P=S/(1+i)^n= Sv^n, \quad (5)$$

where

$$v=1/(1+i). \quad (6)$$

If in the above formulas $1+i$ is replaced by $(1+j/m)^m$, to which it is equivalent according to formula (2), it follows that

$$S=P(1+j/m)^{mn}, \quad (7)$$

and

$$P=S/(1+j/m)^{mn}= Sv^{mn}, \quad (8)$$

where

$$v=1/(1+j/m). \quad (9)$$

These formulas express the relation between P and S in terms of the nominal rate j and the frequency of conversion m . The values to seven places of decimals of $(1+i)^n$ and v^n for various rates of interest and for 60 intervals or years are given in Tables 31 and 34.

Example 3.—To find the amount of \$12,375 at 3% compound interest in 30 years. By formula (4)

$$S=(1+.03)^{30} \times \$12,375=2.4272625 \times \$12,375=\$30,037.37.$$

The value of $(1.03)^{30}$ was taken from Table 31.

Example 4.—\$12,375 is placed in a bank; to find the amount in 30 years if interest is 3% and is compounded semiannually.

The nominal rate of 3%, convertible twice a year, requires formula (7) with $j=.03$ and $m=2$. Substituting, the result is:

$$S=(1+.03/2)^{2 \times 30} \times \$12,375=(1.015)^{60} \times \$12,375=2.4432198 \times \$12,375=\$30,234.85.$$

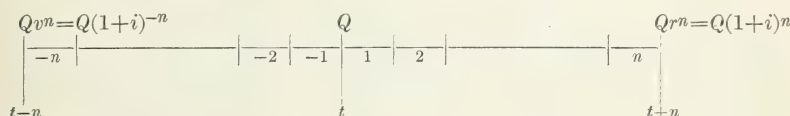
The discount factor.—Because of the power of money to earn interest the value of money depends upon the time to which it is referred. Then in order to compare sums of money due at different times, they must be referred to the *same point in time*.

Formula (5) gives the principal P which will accumulate at the effective rate i in n years to the amount S . If $S=1$ and $n=1$, the formula gives the present value of 1 due in one year. This is usually denoted by the symbol v , so that

$$v = 1/(1+i) = (1+i)^{-1}.$$

Similarly $v^2 = 1/(1+i)^2 = (1+i)^{-2}$ is the present value of 1 due in two years, and $v^n = 1/(1+i)^n = (1+i)^{-n}$ is the present value of 1 due in n years.

The symbol v is often called the discount factor, and if it is desired to find the value of money n years *before the point in time under consideration*, it is necessary only to multiply the quantity by v^n . The factor $1+i$, which is frequently denoted by r , is accumulative in character, and formula (4) shows that, to find the value of a quantity of money Q , n years *after the point in time under consideration*, it is necessary merely to multiply the quantity by $(1+i)^n$.



More generally, when i is the effective rate per interval, the value of Q , at a time n intervals after the point t , is $Q(1+i)^n = Qr^n$, and its value n intervals before point t is $Q(1+i)^{-n} = Qv^n$.

Annuities-certain.—An *annuity* is a series of payments made at *equal intervals* during the continuance of a given *status*.

The *status*, or condition of payment of the annuity, may take a variety of forms. If the status is a fixed term of years, the annuity is an *annuity-certain*. Thus payments of one hundred dollars a year for ten years constitute an annuity-certain. The sum of the payments on an annuity in one year, when the payments are of the same amount, is the *annual rent*.

Payments of twenty-five dollars are made at the end of every month for ten years. This is an annuity-certain with an annual rent of three hundred dollars.

When payments are made at the *end* of each interval, the annuity-certain is said to be *immediate*; when payments are made at the *beginning* of each interval, the annuity-certain is said to be *due*.

Amount of an immediate annuity-certain.—The value of an annuity at the end of its term is called the *amount*. The amount of an immediate annuity-certain for n years with an annual rent 1.

payable at the end of each year, is designated by the symbol $s_{\overline{n}|}$. To find $s_{\overline{n}|}$ each annual payment must be accumulated, at the effective rate of interest i , to the end of the term of the annuity. The first payment of 1 accumulates in $n-1$ years to $(1+i)^{n-1}$; the second payment of 1, in $n-2$ years, to $(1+i)^{n-2}$; etc. . . . ; the $(n-1)$ th payment of 1, in 1 year, to $(1+i)$; and the n th payment at the end of the term is 1. Adding the separate amounts in reverse order, there results

$$s_{\overline{n}|} = 1 + (1+i) + (1+i)^2 + \dots + (1+i)^{n-1}.$$

The sum of this geometric series is

$$s_{\overline{n}|} = \frac{(1+i)^n - 1}{i}. \quad (10)$$

Values of this quantity are given for various rates of interest and terms in Table 32.

Example 5.—To find the accumulation in 47 years of an annual sinking fund of 1% of \$1,000,000, if the fund is credited annually with 3% compound interest.

This is an application of formula (10) where $n=47$ and $i=.03$; since $s_{\overline{47}|} = 100.3965009$ the accumulation will be

$$100.3965009 \times \$10,000 = \$1,003,965.01.$$

The same principles may be applied to find the amount of an annuity for n years with annual rent 1 payable in p equal installments during each year. The amount of such an annuity is designated by the symbol $s_{\overline{n}|}^{(p)}$, and its value is represented by the following formula:

$$s_{\overline{n}|}^{(p)} = \frac{(1+i)^n - 1}{p[(1+i)^{1/p} - 1]}. \quad (11)$$

If $1+i$ is replaced by $(1+j/m)^m$ in accordance with formula (2), the amount of the annuity is then expressed in terms of the nominal rate of interest j with frequency of conversion m , thus:

$$s_{\overline{n}|} = \frac{(1+j/m)^{mn} - 1}{(1+j/m)^m - 1}, \quad (12)$$

$$s_{\overline{n}|}^{(p)} = \frac{(1+j/m)^{mn} - 1}{p[(1+j/m)^{m/p} - 1]}. \quad (13)$$

Example 6.—What will be the accumulation in 47 years of an annual sinking fund of 1% of \$1,000,000, paid in semiannually, if the fund is credited as received with 3% interest compounded annually?

This is an application of formula (11) where $n=47$, $p=2$, $i=.03$, hence

$$s_{\overline{47}|}^{(2)} = \frac{(1+.03)^{47} - 1}{2[(1+.03)^{\frac{1}{2}} - 1]} = \frac{3.0118950}{.0297783} = 101.143954$$

and the accumulation will be $101.143954 \times \$10,000 = \$1,011,439.54$.

The special case where interest is converted with the same frequency as the payment of annuity installments, or when $m=p$, deserves particular mention. Formula (13) then reduces to

$$s_{\overline{n}|}^{(p)} = \frac{1}{p} \cdot \frac{(1+j/p)^{np} - 1}{j/p} = \frac{1}{p} \cdot s_{\overline{np}|}, \quad (14)$$

where $s_{\overline{np}|}$ is to be taken at the effective rate j/p .

Example 7.—What will be the accumulation in 47 years of an annual sinking fund of 1% of \$1,000,000, paid in semiannually, if the fund is credited with a nominal rate of 3% convertible twice a year?

This is an application of formula (14) where $n=47$, $p=2$, and $s_{\overline{94}|}$ is taken at $1\frac{1}{2}\%$; hence

$$\frac{1}{2} s_{\overline{94}|} \times \$10,000 = \$1,017,764.25.^1$$

Sinking fund which will amount to 1.—An annuity with annual rent of 1 will amount in n years to $s_{\overline{n}|}$; it follows that an annuity with annual rent of $1/s_{\overline{n}|}$ will amount in n years to 1. The quantity $1/s_{\overline{n}|}$ is the *sinking fund* which will accumulate to 1 in n years.

Values for this important function

$$\frac{1}{s_{\overline{n}|}} = \frac{i}{(1+i)^n - 1} \quad (15)$$

are given for various rates of interest and for terms ranging from 1 to 60 intervals or years in Table 33.

Example 8.—To find an annual sinking fund, which, credited with 3% compound interest, will accumulate in 50 years to \$1,000,000.

Applying formula (15) where $n=50$, and $i=.03$, there results $1/s_{\overline{50}|} = .0088655$. Therefore the required sinking fund is

$$.0088655 \times \$1,000,000 = \$8,865.50.$$

In like manner $1/s_{\overline{n}|}^{(p)}$ is the annual rent of an annuity which, at the nominal rate j convertible m times a year, will accumulate to 1 in n years. The annual rent is payable in p installments during each year; hence each installment is equal to $1/ps_{\overline{n}|}^{(p)}$. The installments may be regarded as the sinking fund, payable at the end of every p th part of a year, which in n years will accumulate to 1. The amount of each payment to the sinking fund is

$$\frac{1}{ps_{\overline{n}|}^{(p)}} = \frac{(1+j/m)^{m/p} - 1}{(1+j/m)^{mn} - 1}. \quad (16)$$

When $p=1$ and $m=2$, formula (16) gives the value of the *annual* sinking fund which, improved at compound interest *semiannually*, will accumulate in n years to 1.

The formula simplifies to the following:

$$\frac{(1+j/2)^2 - 1}{j/2} \cdot \frac{j/2}{(1+j/2)^{2n} - 1} = s_{\overline{2}|} \cdot \frac{1}{s_{\overline{2n}|}} \quad \text{at } j/2\%. \quad (17)$$

This formula is of considerable practical importance because payments to the sinking fund are usually made annually and the fund

¹ For calculation of $s_{\overline{94}|}$ see Example 22, page 113.

credited with interest semiannually. Table 6, on page 15, was calculated by formula (17).

Example 9.—To find the annual payment which will accumulate in 20 years to \$100,000 when interest is $3\frac{1}{2}$ per cent compounded semiannually.

Taking $n=20$ and $j=.035$ and consulting Tables 32 and 33 with $1\frac{3}{4}$ per cent interest for values of $s_{\overline{2}|}$ and $1/s_{\overline{40}|}$, respectively, there results:

$$s_{\overline{2}|} \cdot \frac{1}{s_{\overline{40}|}} = 2.0175 \times .0174721 = .0352500.$$

Hence the annual payment to sinking fund is

$$.0352500 \times \$100,000 = \$3,525.00.$$

Example 10.—To find the sinking fund, which set aside semiannually and accumulated as received, with 3% compound interest, will amount in 50 years to \$1,000,000.

Here formula (16) is used with $p=2$, $m=1$, $j=.03$, $n=50$, and

$$\frac{1}{2s_{\overline{50}|}^{(2)}} = \frac{(1+.03)^{\frac{1}{2}} - 1}{(1+.03)^{50} - 1} = .00439999.$$

The required sinking fund is therefore

$$.00439999 \times \$1,000,000 = \$4,399.99.$$

In the special case when the frequency of conversion coincides with the number of payments per annum, or $m=p$, the amount of *each payment* to the sinking fund is

$$\frac{1}{ps_{\overline{n}|}^{(p)}} = \frac{j/p}{(1+j/p)^{np} - 1} = \frac{1}{s_{\overline{np}|}}, \quad (18)$$

where $s_{\overline{np}|}$ is to be taken at rate j/p .

Example 11.—To find a sinking fund which, set aside semiannually and credited with a nominal rate of 3% convertible twice a year, will accumulate in 30 years to \$1,000,000.

Here apply formula (18) by substituting $p=2$, $j=.03$, and $n=30$; this gives

$$\frac{1}{2s_{\overline{30}|}^{(2)}} = \frac{1}{s_{\overline{60}|}} = .0103934,$$

where $1/s_{\overline{60}|}$ is taken at $1\frac{1}{2}\%$. Then the sinking fund which would accumulate to \$1,000,000 is

$$.0103934 \times \$1,000,000 = \$10,393.40.$$

Four important cases of sinking funds are illustrated in the preceding examples. They arise from the fact that payments to a sinking fund may be annual or semiannual and interest on a sinking fund annual or semiannual. Formula (16) covers all of them when p and m are properly chosen. The following schedule illustrates this fact:

Case.	p	Sinking-fund payments.	m	Interest on sinking fund.	Illustrated in example.
1	1	Annual	1	Annual	8
2	1	Annual	2	Semiannual	9
3	2	Semiannual	1	Annual	10
4	2	Semiannual	2	Semiannual	11

In most cases in the illustrative tables in the body of this bulletin, for simplicity of presentation, annual payments and annual interest are assumed, whereas in practice usually annual payments and semi-annual interest are employed.

Present value of an immediate annuity-certain.—The present value of an immediate annuity-certain for n years, with annual rent 1 payable at the end of each year, is designated by the symbol $a_{\overline{n}|}$.

It is equal to the sum of the present values of 1, due at the succeeding yearly intervals. By formula (5) the present value of 1, due at the end of one year at the effective rate of interest i , is $v=1/(1+i)$; at the end of two years, $v^2=1/(1+i)^2$, etc.; at the end of n years, $v^n=1/(1+i)^n$. Hence

$$\begin{aligned} a_{\overline{n}|} &= v + v^2 + \dots + v^n \\ &= \frac{1}{1+i} + \frac{1}{(1+i)^2} + \dots + \frac{1}{(1+i)^n}. \end{aligned}$$

The sum of this geometric series is

$$a_{\overline{n}|} = \frac{1 - v^n}{i} = \frac{1 - (1+i)^{-n}}{i} \quad (19)$$

and its values are given in Table 35.

Example 12.—To find the present value at 3% of an annual payment of \$56,325 at the end of each year for thirty years.

Referring to Table 35, it is seen that $a_{\overline{30}|}$ at 3% is 19.6004413, and therefore the required present value is

$$19.6004413 \times \$56,325 = \$1,103,994.86.$$

While the above demonstration relates to an annuity of 1 per annum, payable at the end of each year, the same principles apply to finding the present value of an annuity of 1 per annum, payable in p installments during each year. The present value of such an annuity is designated by the symbol $a_{\overline{n}|}^{(p)}$, and its value is represented by the following formula:

$$a_{\overline{n}|}^{(p)} = \frac{1 - v^n}{p[(1+i)^{1/p} - 1]} = \frac{1 - (1+i)^{-n}}{p[(1+i)^{1/p} - 1]}. \quad (20)$$

In formulas (19) and (20) the values of the annuities are expressed in terms of the effective rate i . If $(1+i)$ is replaced by $(1+j/m)^m$ in accordance with formula (2), there result the present values of the same annuities expressed as follows in terms of the nominal rate of interest j , with frequency of conversion m :

$$a_{\overline{n}|} = \frac{1 - (1+j/m)^{-mn}}{(1+j/m)^m - 1}, \quad (21)$$

and

$$a_{\overline{n}|}^{(p)} = \frac{1 - (1+j/m)^{-mn}}{p[(1+j/m)^{m/p} - 1]}. \quad (22)$$

Fundamental relations between the present value and the amount of an annuity.—Since $a_{\overline{n}|}$ and $s_{\overline{n}|}$ are the values of the same annuity upon two dates differing by n years, it follows by the principle of reduction of values from one date to another, explained on page 95, that

$$a_{\overline{n}|} = v^n s_{\overline{n}|},$$

$$s_{\overline{n}|} = (1+i)^n a_{\overline{n}|},$$

and in like manner that

$$a_{\overline{n}|}^{(p)} = v^n s_{\overline{n}|}^{(p)},$$

$$s_{\overline{n}|}^{(p)} = (1+i)^n a_{\overline{n}|}^{(p)}.$$

As tables are not published giving the values of $a_{\overline{n}|}^{(p)}$ and $s_{\overline{n}|}^{(p)}$, when p is different from 1, it is desirable for purposes of computation to express a relation between these functions and the tabulated functions $a_{\overline{n}|}$ and $s_{\overline{n}|}$. This can easily be done by accumulating to the end of each year the p payments of $1/p$ which in $a_{\overline{n}|}^{(p)}$ and $s_{\overline{n}|}^{(p)}$ are distributed at equal intervals through the year. By formula (11) this accumulation to the end of each year will be equal to

$$s_{\overline{1}|}^{(p)} = \frac{i}{p[(1+i)^{1/p} - 1]} = \frac{i}{j_{(p)}}.$$

This converts the annuity into one with annual rent $s_{\overline{1}|}^{(p)}$ payable at the end of each year for n years. Therefore

$$a_{\overline{n}|}^{(p)} = s_{\overline{1}|}^{(p)} a_{\overline{n}|}, \quad (23)$$

$$s_{\overline{n}|}^{(p)} = s_{\overline{1}|}^{(p)} s_{\overline{n}|}. \quad (24)$$

The most frequent intervals in practice are semiannual, quarterly, and monthly, and to meet this requirement the values of $s_{\overline{1}|}^{(2)}$, $s_{\overline{1}|}^{(4)}$, and $s_{\overline{1}|}^{(12)}$ are given below for various rates of interest.

Values of $s_{\overline{1}|}^{(p)} = i/j_{(p)} = \frac{i}{p[(1+i)^{1/p} - 1]}$							
p	1½%	1¾%	2%	2¼%	2½%	2¾%	3%
2	1.00373604	1.00435603	1.00497525	1.00559371	1.00621142	1.00682837	1.00744458
4	1.00560755	1.00653878	1.00746906	1.00839839	1.00932677	1.01025422	1.01118072
12	1.00685652	1.00799571	1.00913389	1.01027107	1.01140725	1.01254243	1.01367662
p	3½%	4%	4½%	5%	5½%	6%	7%
2	1.00867475	1.00990195	1.01112621	1.01234754	1.01356596	1.01478151	1.01720402
4	1.01303094	1.01487744	1.01672026	1.01856942	1.02039495	1.02222688	1.02588002
12	1.01594203	1.01820351	1.02046109	1.02271479	1.02496465	1.02721070	1.03169143

Example 13.—What is the present value of an annuity for 30 years at effective rate 3%, payable in monthly installments of \$25?

By formula (23) with $n=30$, $p=12$, $i=.03$,

$$a_{\overline{30}|}^{(12)} = s_{\overline{1}|}^{(12)} \cdot a_{\overline{30}|} = 1.01367662 \times 19.6004413 = 19.86850909.$$

Therefore the present value of a similar annuity of \$25 per month, or with annual rent of \$300, is

$$19.86850909 \times \$300 = \$5,960.55.$$

The annuity which 1 will purchase.—The present value $a_{\overline{n}|}$ of an annuity may be viewed as the principal which, invested at the effective rate of interest i , will provide a payment of 1 at the end of each year and will not be exhausted until the end of the n th year; in other words, $a_{\overline{n}|}$ is just sufficient to purchase an n year annuity of annual rent 1 payable at the end of each year. By proportion it appears that 1 will purchase an n year annuity of annual rent $1/a_{\overline{n}|}$ payable at the end of each year. This quantity may be described as the annuity which 1 will purchase, and its value is

$$\frac{1}{a_{\overline{n}|}} = \frac{i}{1-v^n} = \frac{i}{1-(1+i)^{-n}}. \quad (25)$$

This function is of great importance in annuity bond calculations, and its values are given for 60 terms and different rates of interest in Table 36, on pages 126 and 127.

Example 14.—To find the uniform annual payment which in 20 years will discharge a loan of \$100,000, including both principal and interest, at 5 per cent compounded annually.

In this case $n=20$, $i=.05$; employing formula (25) and referring to Table 36, it follows that a loan of 1 will be discharged, both principal and interest, by an annual payment of

$$\frac{1}{a_{\overline{20}|}} = .0802426;$$

hence the loan of \$100,000 will be likewise discharged by an annual payment of

$$.0802426 \times \$100,000 = \$8,024.26.$$

By similar reasoning it follows that 1 will purchase an immediate annuity-certain with annual rent $1/a_{\overline{n}|}^{(p)}$, payable in p installments each year. The value of each *periodical installment* is

$$\frac{1}{pa_{\overline{n}|}^{(p)}} = \frac{(1+j/m)^{m/p} - 1}{1 - (1+j/m)^{-mn}}, \quad (26)$$

where interest is at the nominal rate j with frequency of conversion m . When $m=1$, the nominal rate $j_{(1)}$ becomes the effective rate i . When the conversion of interest occurs with the same frequency as the periodical payment, that is, when $m=p$, formula (26) reduces to the important particular case

$$\frac{1}{pa_{\overline{n}|}^{(p)}} = \frac{j/p}{1 - (1+j/p)^{-np}} = \frac{1}{a_{\overline{np}|}}, \quad (27)$$

where $a_{\overline{np}|}$ is to be taken at j/p per cent.

Example 15.—To find the half yearly payment at 5% compounded semiannually which will discharge both principal and interest on a loan of \$100,000 in three years.

By formula (27) with $n=3$, $p=2$, a loan of 1 will be discharged, both principal and interest, in three years by a semiannual payment of

$$\frac{1}{a_{\overline{6}|} \text{ (taken at } 2\frac{1}{2}\%)} = .1815500,$$

and the loan of \$100,000 will be discharged in like manner by

$$.1815500 \times \$100,000 = \$18,155.00.$$

Installment annuity loan.—The preceding example shows how the function $1/a_n$ may be employed to determine the periodical fixed payment which in n years will discharge both principal and interest on a loan. It is to be noted particularly that the lender receives interest throughout the term of the loan on all *outstanding* principal. The following schedule, based on the above example, illustrates the progress of the loan.

SCHEDULE I.—*Showing repayment of principal and interest on a loan of \$100,000 by six equal semiannual payments, each of \$18,155; interest 5 per cent, compounded semi-annually.*

Year.	Principal outstanding at beginning of interval.	Interest for interval.	Semiannual payment.	Principal repayment for interval.
$\frac{1}{2}$	\$100,000.00	\$2,500.00	\$18,155.00	\$15,655.00
1	84,345.00	2,108.63	18,155.00	16,046.37
$1\frac{1}{2}$	68,298.63	1,707.47	18,155.00	16,447.53
2	51,851.10	1,296.28	18,155.00	16,858.72
$2\frac{1}{2}$	34,992.38	874.81	18,155.00	17,280.19
3	17,712.19	442.81	18,155.00	17,712.19
Totals	357,199.30	8,930.00	108,930.00	100,000.00

The initial invested principal of \$100,000 earns \$2,500 interest during the first half year; the first payment of \$18,155.00 takes care of this and there remains a balance of \$15,655.00 which goes to reduce the outstanding principal to \$84,345.00, beginning with the second half year. This process is repeated until the end of the third year, when the last outstanding principal is retired. When preparing such a schedule, the work can be checked by adding the columns. It is evident from the nature of the calculations that, for example, if the first row were omitted from this schedule, the remaining five would represent the schedule for a loan of \$84,345.00 on the same terms as the original loan, except that it would be discharged in two and one-half years by five equal semiannual payments. It must therefore be the present value of the five payments, that is,

$$a_{\overline{5}|} \times \frac{\$100,000}{a_{\overline{6}|}} = \$84,345.00,$$

where the annuities are taken at $2\frac{1}{2}$ per cent. Similarly, by successively employing $a_{\overline{4}|}$, $a_{\overline{3}|}$, $a_{\overline{2}|}$, and $a_{\overline{1}|}$, all at $2\frac{1}{2}$ per cent, as multipliers, the figures in the first column of principal outstanding at the beginning of the interval could be obtained. When these are known, the figures in the second column are obtained by multiplying the corresponding figures in the first column by the interest rate for the interval, .025; in the fourth, by successive subtractions of the figures

in the first; and in the third, by adding those in the second to those in the fourth as a check.

Generalization of the annuity loan.—The preceding discussion can most easily be generalized by considering the loan of $a_{\overline{n}|}$ dollars where both principal and interest at *effective rate* i *per annum* are discharged by equal annual installments of 1 at the end of each year for n years. The initial principal is $a_{\overline{n}|}$; the interest, $ia_n = 1 - v^n$; the annual payment, 1, of which $1 - (1 - v^n) = v^n$ is applied to repayment of principal. But $a_{\overline{n}|} - v^n = a_{\overline{n-1}|}$; hence the outstanding principal at the beginning of the second year is $a_{\overline{n-1}|}$, as might have been predicted in advance. A repetition of this process leads to the following schedule:

SCHEDULE II.—*Showing repayment of principal and interest at effective rate i per annum on a loan of $a_{\overline{n}|}$ by equal annual payments of 1 at the end of each year for n years.*

Year.	Principal outstanding at begin- ning of year.	Interest due at end of year.	Annual pay- ment at end of year.	Principal repaid at end of year.
1	$a_{\overline{n}|}$	$1 - v^n$	1	v^n
2	$a_{\overline{n-1}|}$	$1 - v^{n-1}$	1	v^{n-1}
3	$a_{\overline{n-2}|}$	$1 - v^{n-2}$	1	v^{n-2}
:	:	:	:	:
k	$a_{\overline{n-k+1}|}$	$1 - v^{n-k+1}$	1	v^{n-k+1}
:	:	:	:	:
n	$a_{\overline{1}|}$	$1 - v$	1	v
Totals	$(n - a_{\overline{n}|})/i$	$n - a_{\overline{n}|}$	n	$a_{\overline{n}|}$

Since this is a schedule for a loan of $a_{\overline{n}|}$, if each item in it, apart from those in the column headed "year," is divided by $a_{\overline{n}|}$ and multiplied by L , there results the corresponding schedule for a loan of L dollars.

For example, the items on a loan of L dollars for the k th year would be

$$La_{\overline{n-k+1}|}/a_{\overline{n}|}, \quad L(1 - v^{n-k+1})/a_{\overline{n}|}, \quad L/a_{\overline{n}|}, \quad Lv^{n-k+1}/a_{\overline{n}|}. \quad (28)$$

There are some curious properties revealed by the above schedule, among which the following may be pointed out. The principal repayments on an annuity loan increase in geometrical progression, the factor being $1 + i$. The sum of these repayments is $a_{\overline{n}|}$; the sum of the annual payments is n ; the total interest is $n - a_{\overline{n}|}$; and the check on the first and second columns shows that

$$i(a_{\overline{1}|} + a_{\overline{2}|} + \dots + a_{\overline{n}|}) = n - a_{\overline{n}|}.$$

It is apparent that most of the items in the schedule can be filled in directly from the $a_{\overline{n}|}$ and v^n tables. Having thus filled in each

number, it would be necessary only to multiply each item by $L/a^{\overline{n}}$ to obtain the corresponding schedule for a loan of L .

If in the preceding discussion *year* is replaced by *interval*, the schedule may be made to apply to loans repaid by equal installments at the end of each interval.

Relation between annuity which 1 will purchase and sinking fund which will amount to 1.—The important relation

$$\frac{1}{a^{\overline{n}|i}} = \frac{1}{s^{\overline{n}|i}} + i \quad (29)$$

can easily be verified by substitution of the values of $1/a^{\overline{n}|i}$ and $1/s^{\overline{n}|i}$ expressed in terms of i , by formulas (25) and (15).

The relation (29) merely expresses the fact that the annual rent, $1/a^{\overline{n}|i}$ on the annuity which 1 will purchase, must include, not only the interest i on the unit so invested, but also a sinking fund, $1/s^{\overline{n}|i}$, which will accumulate to the invested unit at the end of the term of the annuity.

Application to bond calculations.—An important application of the theory of compound interest and annuities arises in the valuation of bonds. First to determine the value of a bond issue redeemable in one sum on a given date, with interest, or dividends, on the outstanding bonds at rate g , and all computed, or *valued*, so as to yield the purchaser a given effective rate of interest i . Consider an issue of \$100,000 highway bonds, denomination \$500, dated January 1, 1914, maturing January 1, 1948, interest 5 per cent, payable annually.

The annual interest, or dividends, on these bonds is 5 per cent, and the bonds are redeemed at the end of 34 years. Suppose an intending purchaser desires to pay a price which will yield a net income of 3 per cent on his investment; how much ought he to bid? This is the nature of the general problem. If the purchaser desires to realize 5 per cent on his investment, he must bid \$100,000 for the bonds, or \$1 for each dollar to be redeemed. If, however, he is content with 3 per cent, more than \$100,000 must be paid for the bonds, that is, more than \$1 for each dollar to be redeemed. In this case the bonds are said to be bought at a *premium*; if less than \$1 is paid for each dollar to be redeemed, the bonds are said to be bought at a *discount*.

In the general case, let C denote the price to be paid on redemption; i , the effective rate of interest employed in the valuation of the bonds, which is the *net income* rate to the purchaser; g , the *ratio* of the dividend per annum to C ; n , the number of years after which the bonds are redeemed; K , the present value of C , due n years hence,

at the effective rate of interest i ; and A , the present value of, or bid on, the bonds.

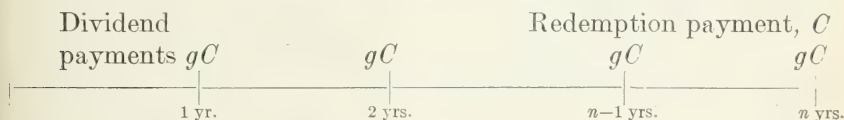
In the above illustration $C=100,000$, and $n=34$. The dividend or interest per annum is 5,000. Hence $g=5,000/100,000=.05$.

Returning to the general problem, the value of the bonds, so far as the purchaser or holder is concerned, consists of two parts:

1. *The annual interest, or dividend, to be received.*

2. *The sum to be redeemed at the end of n years.*

Hence, to find the present value, A , of the bonds, the present value of each of these parts must be determined and added together. The interest per unit of the redemption price C is, by definition, g ; if the interest on 1 unit is g , the interest on C units is gC . Hence at the end of every year for n years the holder will receive gC units.



It is evident that these interest or dividend payments of gC at the end of every year constitute an immediate annuity-certain of annual rent gC and term of n years. The value of such an annuity with annual rent 1 is $a_{\overline{n}|}$; hence the value of the annuity with annual rent gC is

$$gC a_{\overline{n}|},$$

where $a_{\overline{n}|}$ is to be taken at the rate of interest i to be employed in the valuation of the bonds, a rate which in general is different from g , the rate of dividend.

By formula (5), the present value of the sum C , to be redeemed in n years, is $v^n C$.

Adding these parts together, the result is

$$A = v^n C + gC a_{\overline{n}|}.$$

Substituting in this relation the value of $a_{\overline{n}|}$ given by formula (19), it follows that

$$A = v^n C + \frac{g}{i}(C - v^n C).$$

Since, by definition, $K = v^n C$, the bid is given by

$$A = K + \frac{g}{i}(C - K) \quad (30)$$

and the premium by

$$A - C = (C - K) \frac{(g - i)}{i}. \quad (31)$$

If in formula (31) the *total sum to be redeemed is regarded as unity*, then $C=1$ and $K=v^n$, the present value of 1 due in n years, and there results

$$A = 1 + \frac{(1-v^n)}{i}(g-i) = 1 + (g-i)a_{\overline{n}|i}. \quad (32)$$

In this formula $a_{\overline{n}|}$ is taken at i per cent, and gives the bid on a bond where the sum to be redeemed is 1. Denoting the excess of A over 1 by k , which is called the *premium*, formula (32) becomes

$$k = (g-i)a_{\overline{n}|i}^{i\%}, \quad (33)$$

where the i per cent over the symbol $a_{\overline{n}|}$ means that the function is to be taken from the i per cent annuity table.

This is the fundamental formula in bond calculations. It admits of a very simple interpretation, for it states that the premium on a bond is equal to the present value of an n year annuity at i per cent whose annual rent is the excess $(g-i)$ of the nominal rate of dividend of the bond over the effective rate of interest i , desired to be realized by the investor.

		Unit redeemed, 1			
Unit invested, 1		$\frac{i}{1 \text{ yr.}}$	$\frac{i}{2 \text{ yrs.}}$	$\frac{i}{n-1 \text{ yrs.}}$	$\frac{i}{n \text{ yrs.}}$
Premium, k		$g-i$	$g-i$	$g-i$	$g-i$

The dividend paid each year on each unit of the bond to be redeemed is g , which may be divided into two parts, i and $g-i$. For the first part the investor pays 1 and in return receives interest of i each year and the 1 is redeemed at the end of n years. For the second part the investor pays the premium, $k=(g-i)a_{\overline{n}|}$, and this is repaid, both principal and interest at rate i , in n equal annual installments of $(g-i)$. A portion of each installment goes toward the repayment of the premium k which is eventually reduced to zero. This is called the *amortization or writing off of the premium*.

It is thus seen that, if k is positive, the bond is bought at a premium; and if k is negative, it is bought at a discount. Since $a_{\overline{n}|}$ is always positive, it appears from formula (33) that the sign of k will be positive when g is greater than i , or *when the rate of dividend is greater than the rate of interest used in valuation*; conversely, when g is less than i , k is negative.

Example 16.—To find the bid on the highway bond mentioned on page 104, on the hypothesis that the purchaser wishes to realize 3% on his investment.

Consider a dollar (unit) of the loan $C=100,000$. Here $n=34$, $g=.05$, $i=.03$, and by formula (33),

$$k = (.05 - .03)a_{\overline{34}|3\%} = .02 \times 21.1318367 = .422636734,$$

or the premium is slightly over 42 cents on the dollar. Since for each dollar of the loan the purchaser must pay \$1.422636734, for the whole loan of \$100,000 he must pay

$$1.422636734 \times \$100,000 = \$142,263.67.$$

Dividends payable and interest convertible semiannually.—

When the net income interest rate desired by the investor is nominal, say $j_{(m)}$, and the dividends per unit of the sum to be redeemed are paid in m equal installments, g/m , during the year, it is evident that it is a case of m times n intervals with g/m as dividend and j/m as the *effective rate of interest per interval*. Hence formula (33) becomes

$$K = \frac{(g-j)}{m} a_{\frac{j}{m}\%}^{\frac{1}{mn}}. \quad (34)$$

In particular, if the net income is $j_{(2)}$, and the dividend payments are semiannual,

$$K = \frac{(g-j)}{2} a_{\frac{j}{2}\%}^{\frac{1}{2n}}. \quad (35)$$

This formula provides for the valuation of all bonds, redeemed in one sum at the end of a term of n years and with semiannual dividends. Particular attention is called to the fact that the annuity must be taken for the term $2n$, and at the rate of interest $j/2$.

Example 17.—What is the bid on \$100,000 highway 5% bonds maturing at the end of 3 years, interest payable semiannually, to net purchaser a nominal rate of 4% convertible half-yearly?

Here $n=3$, $g=.05$, $j=.04$, $m=2$, and formula (35) gives

$$K = \frac{(.05-.04)}{2} a_{\frac{2\%}{6}}^{\frac{1}{6}} = .005 \times 5.6014309 = .0280071545.$$

Hence the premium on \$100,000 is \$2,800.72, and the corresponding bid is \$102,800.72. The progress of this bond loan is illustrated in the following schedule.

SCHEDULE III.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Semiannual dividend of 2½% on bonds.	Amortization of premium at end of half-year.	Redemption payment at end of half-year.
½	\$102,800.72	\$2,056.01	\$2,500.00	\$443.99	0.00
1	102,356.73	2,047.13	2,500.00	452.87	0.00
1½	101,903.86	2,038.08	2,500.00	461.92	0.00
2	101,441.94	2,028.84	2,500.00	471.16	0.00
2½	100,970.78	2,019.42	2,500.00	480.58	0.00
3	100,490.20	2,009.80	2,500.00	490.20	\$100,000.00
Totals	609,964.23	12,199.28	15,000.00	2,800.72	100,000.00

At the outset the holder has an investment of \$102,800.72 upon which, at 2 per cent, at the end of the first half-year, \$2,056.01 interest is due; the dividend payment of \$2,500.00 then made on the bonds provides for this interest and a balance of \$443.99 remains, which is applied to *amortize* or *write off* the premium so that the *book-value*, or invested principal, is reduced to \$102,356.73 at the beginning of the second half-year. This process continues for three years until the entire premium of \$2,800.72 is written off and the bonds are redeemed by the payment of \$100,000. The various columns are added and the checks upon these totals are obvious.

Example 18.—What is the bid on \$100,000 highway 3% bonds maturing at the end of 3 years, interest payable semiannually, to net purchaser a nominal rate of 4% convertible half-yearly?

Here $n=3$, $g=.03$, $j=.04$, $m=2$, and formula (35) gives

$$k = \frac{(.03 - .04)}{2} a_{\overline{6}|}^{2\%} = -.005 \times 5.6014309 = -.0280071545.$$

Hence the *discount* on \$100,000 is \$2,809.72, and the corresponding bid is \$97,199.28. The progress of this bond loan is illustrated in the following schedule.

SCHEDULE IV.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Semiannual dividend of $1\frac{1}{2}\%$ on bonds.	Accumulation of discount at end of half-year.	Redemption payment at end of half-year.
$\frac{1}{2}$	\$97,199.28	\$1,943.99	\$1,500.00	\$443.99	0.00
1	97,643.27	1,952.87	1,500.00	452.87	0.00
$1\frac{1}{2}$	98,096.14	1,961.92	1,500.00	461.92	0.00
2	98,558.06	1,971.16	1,500.00	471.16	0.00
$2\frac{1}{2}$	99,029.22	1,980.58	1,500.00	480.58	0.00
3	99,509.80	1,990.20	1,500.00	490.20	\$100,000.00
Totals	590,035.77	11,800.72	9,000.00	2,800.72	100,000.00

In this case the holder has an initial investment of \$97,199.28, and at the end of the first half-year 2 per cent interest, or \$1,943.99, is due. The dividend payment of \$1,500.00, then made on the bonds, is *not sufficient* to provide for this interest, and the difference of \$443.99 is added to the principal and determines the *book value* at the beginning of the second half-year. This is called the *accumulation* or *writing on* of discount. By continuing this process for three years the entire discount of \$2,800.72 is written on the initial principal, and the book value, \$100,000, is then redeemed. The totals of the several columns may be used to check the numerical work.

Valuation of bonds redeemed in installments.—For the valuation of bonds which are not redeemed in one sum, but in a series of installments, first consider the simpler case where the dividend payments are annual and the rate of interest is the effective rate i .

Let C_1, C_2, \dots, C_r , denote the successive installments by which the bonds are to be redeemed;

n_1, n_2, \dots, n_r ,

the respective number of years after which the successive installments become due;

K_1, K_2, \dots, K_r ,

the present values, at the effective rate of interest i , of

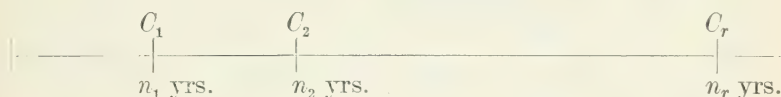
C_1 due n_1 years hence,

C_2 due n_2 years hence,

$\dots \dots \dots$

C_r due n_r years hence;

g , the fixed rate of dividend to be paid on the *outstanding* bonds;
 i , the effective rate of interest employed in the valuation of the bonds, which is the *net income* rate to the purchaser;
 and $A_1, A_2, \dots A_r$, the present values, at the effective rate i , of the separate installments *with their respective dividends*.



Each installment redeemed may be regarded as furnishing a distinct problem under formula (30) so that, in order to value the entire bond issue, it may be treated as made up of r distinct issues and, after finding the value of each one, they may be added together for the value or bid on the total issue.

By formula (30) in the case of a single issue of C_1 at *net income* rate i , dividend rate g , due in n_1 years, the present value, or bid, A_1 , is:

$$A_1 = K_1 + (g/i) (C_1 - K_1).$$

Similarly,

$$A_2 = K_2 + (g/i) (C_2 - K_2),$$

$$\dots \dots \dots$$

$$A_r = K_r + (g/i) (C_r - K_r).$$

Adding,

$$(A_1 + A_2 + \dots + A_r) = (K_1 + K_2 + \dots + K_r) + (g/i)[(C_1 + C_2 + \dots + C_r) - (K_1 + K_2 + \dots + K_r)].$$

The total sum to be redeemed, $C_1 + C_2 + \dots + C_r$, is denoted by C ; the total present value of C_1 in n_1 years, C_2 in n_2 years, and so on, which by definition is equal to $K_1 + K_2 + \dots + K_r$, by K ; and the total value of the issue, $A_1 + A_2 + \dots + A_r$, by A ; then for the bid there results

$$A = K + (g/i) (C - K), \quad (36)$$

and for the premium,

$$A - C = (C - K) (g - i)/i. \quad (37)$$

It thus appears that formulas (30) and (31), which were derived before for the case of a bond issue redeemed in one sum, hold also for the more general issue redeemed in any number of installments.

Installment bonds when total sum to be redeemed is 1.—

When 1 is the total sum to be redeemed, that is, when $C=1$, formula (37) becomes

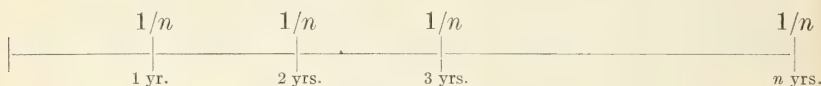
$$A - 1 = (1 - K) (g - i)/i, \quad (38)$$

where A is the value of each unit of the sum to be redeemed, and K is the present value of the various parts of the unit at effective rate i due in $n_1, n_2, \dots n_r$ years. Letting $A - 1 = k$, formula (38) becomes

$$k = (1 - K)(g - i)/i. \quad (39)$$

The premium is positive if g is greater than i , and negative, or a discount, if g is less than i ; for the first factor $(1 - K)$ can not be negative, as K by definition is the *present value* of a series of future payments whose sum is 1, and hence their present discounted value must be less than 1. This shows in all cases that a bond issue must be bought at a *premium*, if it is valued at a *lower* rate i than the rate of dividend g ; and at a discount, if it is valued at a higher rate i than the rate of dividend g .

Serial bonds.—To apply the general formula (39) to the case of a bond issue redeemed by n equal annual installments, consider a unit of the total sum to be redeemed. Since this unit is to be redeemed in n equal installments over n years, the annual portion redeemed is $1/n$.



The present value, K , of these n installments is clearly the value of an annuity of annual rent $1/n$; hence

$$K = a_{\overline{n}|} \times 1/n = a_{\overline{n}|}/n.$$

Substituting this value of K in formula (39), the following formula is obtained:

$$k = (1 - a_{\overline{n}|}/n)(g - i)/i. \quad (40)$$

Example 19.—What is the bid on \$100,000 highway 4% serial bonds maturing in 20 equal annual installments, to net the purchaser an effective rate of 3%?

Here $n=20$, $g=.04$, $i=.03$, and $a_{\overline{20}|}^{3\%}=14.8774749$; consequently

$$\begin{aligned} k &= (1 - 14.8774749/20)(.04 - .03)/.03 \\ &= (1 - .743873745) \times 1/3 = .256126255 \times 1/3 = .085375418. \end{aligned}$$

Hence the bid on \$100,000 is

$$1.085375418 \times \$100,000 = \$108,537.54.$$

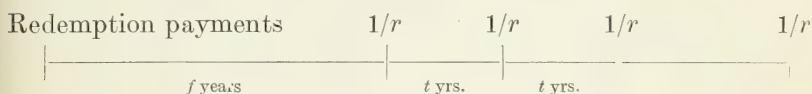
Extension of formulas to case when dividends are payable and interest is convertible m times per annum.—Formula (36) assumes that dividends are payable once a year and that the effective rate of interest is i per annum. Replacing *year* by *interval* and assuming dividends to be paid at the end of each interval and the rate of interest realized by the investor a nominal rate convertible m times a year, formula (36) still applies, if the present value K of the several

installments to be redeemed is calculated at the effective rate j/m per interval, and the dividend per unit of the sum to be redeemed is taken at the rate g/m per interval. The formula is unchanged in form since m cancels out in the ratio g/m to j/m .

General formula for valuation of bonds.—Assume that:

1. The bonds are redeemed in r equal installments.
2. The first redemption of bonds is made at the end of f years.
3. The remaining $r-1$ bond redemptions are made at intervals of t years.
4. The annual rate of dividend is g paid in m equal installments.
5. The bond issue is valued at the nominal rate $j_{(m)}$.

First find the present value, A , of an issue of the above type where $C=1$. The value of a similar total issue of C is then found by multiplying A by C . Since the unit fund is redeemed in r equal installments, each one will be $1/r$.



The total term of the issue is seen to be $f+(r-1)t$ years. As in preceding extension of formulas when dividends are payable and interest is convertible m times per annum, apply formula (36) to each installment of $1/r$ in the unit issue and the formula for the value of k , the premium per unit of the total sum to be redeemed, may readily be obtained. Expressed in terms of annuities, it appears as follows:

$$k = \left[1 - \frac{a_{m(f+tr)} - a_{mf}}{ra_{mt}} \right] (g-j)/j \quad \text{at rate } j/m. \quad (41)$$

The annuity present values in this formula must be computed at the rate of interest j/m . The most common case in practice is where the dividends are paid semiannually. Here $m=2$, and formula (41) becomes:

$$k = \left[1 - \frac{a_{2(f+tr)} - a_{2f}}{ra_{2t}} \right] (g-j)/j \quad \text{at rate } j/2. \quad (42)$$

The last two formulas are very general in their application and have the advantage that when employed in practical computations it is necessary to consult only a table of values of $a_{\overline{n}|}$.

Example 20.—To find the bid on \$1,100,000 highway bonds, interest 5% payable semiannually, dated January 1, 1914, maturing \$100,000 on January 1, 1922, 1924, 1926, 1928, 1930, 1932, 1934, 1936, 1938, 1940, and 1942, to net the purchaser a nominal rate of 4%, compounded semiannually, on his investment.

Here $f=8$, $t=2$, $r=11$, $g=.05$, $m=2$, and $j_{(2)}=.04$. Accordingly, $m(f+tr)=60$, $mf=16$, and $mt=4$. Substituting in formula (42),

$$k = \left[1 - \frac{a_{60} - a_{16}}{11 \times a_{4}} \right] (.05 - .04)/.04 \quad \text{at } 2\%.$$

Entering Table 35 with 2% for the values of the annuities and numbering the successive steps for convenience of explanation, the calculation may be outlined as follows:

$$\begin{aligned} a_{\overline{60}|} &= 34.7608867 & (1) \\ a_{\overline{16}|} &= 13.5777093 & (2) \\ a_{\overline{60}|} - a_{\overline{16}|} &= 21.1831774 & (3) \\ (3) \div 11 &= 1.9257434 & (4) \\ a_{\overline{4}|} &= 3.8077287 \\ (4) \div a_{\overline{4}|} &= .5057460 & (5) \\ \text{Complement of (5)} &= 1 - (.5) = .4942540 & (6) = \text{first factor} \\ (.05 - .04) / .04 &= .25 & (7) = \text{second factor} \\ k &= (6) \times (7) = .1235635. \end{aligned}$$

The bid on one dollar is $1 + k = 1.1235635$; consequently the bid on the whole issue is $1.1235635 \times \$1,100,000 = \$1,235,919.85$.

Example 21.—To find the price of \$100,000 highway bonds, interest 5%, semi-annual, dated January 1, 1914, maturing \$50,000 January 1, 1917, and \$50,000 January 1, 1919, to net the investor 4% compounded semiannually.

In this case $f=3$, $r=2$, $t=2$, $m=2$, $g=.05$, $j=.04$, and, substituting as in the preceding example, the required price is found to be \$103,646.00. The progress of the loan is indicated in the following schedule.

SCHEDULE V.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Semiannual dividend of 2½% on bonds.	Amortization of premium at end of half-year.	Redemption payment at end of half-year.
$\frac{1}{2}$	\$103, 646. 00	\$2, 072. 92	\$2, 500. 00	\$427. 08	0. 00
1	103, 218. 92	2, 064. 38	2, 500. 00	435. 62	0. 00
$1\frac{1}{2}$	102, 783. 30	2, 055. 67	2, 500. 00	444. 33	0. 00
2	102, 338. 97	2, 046. 78	2, 500. 00	453. 22	0. 00
$2\frac{1}{2}$	101, 885. 75	2, 037. 72	2, 500. 00	462. 28	0. 00
3	101, 423. 47	2, 028. 47	2, 500. 00	471. 53	\$50, 000. 00
$3\frac{1}{2}$	50, 951. 94	1, 019. 04	1, 250. 00	230. 96	0. 00
4	50, 720. 98	1, 014. 42	1, 250. 00	235. 58	0. 00
$4\frac{1}{2}$	50, 485. 40	1, 009. 71	1, 250. 00	240. 29	0. 00
5	50, 245. 11	1, 004. 89	1, 250. 00	245. 11	50, 000. 00
Totals	817, 699. 84	16, 354. 00	20, 000. 00	3, 646. 00	100, 000. 00

Extension of term of tables.—It sometimes happens in applying formula (42) that the value of $2(f+tr)$ is greater than the term given in the tables. In example 20 one of the required annuity values was $a_{\overline{60}|}$ but, if the interval between redemptions had been three years instead of two, $2(f+tr)=82$ would have called for the value of an annuity $a_{\overline{82}|}$ beyond the limits of the tables. It is easy, however, to extend these limits by making use of the following obvious relations:

$$v^{m+n} = v^m v^n, \quad (43)$$

$$(1+i)^{m+n} = (1+i)^m (1+i)^n, \quad (44)$$

$$a_{\overline{m+n}|} = [1 - v^m v^n] / i, \quad (45)$$

$$a_{\overline{m+n}|} = a_{\overline{m}|} + v^m a_{\overline{n}|}, \quad (46)$$

$$s_{\overline{m+n}|} = [(1+i)^m (1+i)^n - 1] / i, \quad (47)$$

$$s_{\overline{m+n}|} = (1+i)^n s_{\overline{m}|} + s_{\overline{n}|}. \quad (48)$$

Example 22.—To find $s_{\overline{94}|}$ at $1\frac{1}{2}\%$ when the limit of the tables is 60 years or terms.

Applying formula (47) there results

$$\begin{aligned}s_{\overline{94}|} &= s_{\overline{60+34}|} = \frac{(1.015)^{60+34} - 1}{.015} = \frac{(1.015)^{60} \times (1.015)^{34} - 1}{.015} \\ &= \frac{2.4432198 \times 1.6589964 - 1}{.015} = 203.5528568.\end{aligned}$$

By formula (48)

$$\begin{aligned}s_{\overline{94}|} &= s_{\overline{60+34}|} = (1.015)^{34} \cdot s_{\overline{60}|} + s_{\overline{34}|} \\ &= 1.6589964 \times 96.2146517 + 43.9330915 = 203.5528523.\end{aligned}$$

The correct value of $s_{\overline{94}|}$ at $1\frac{1}{2}\%$ to seven places of decimals is 203.5528497; so the above method may be regarded as giving the correct value to about five places of decimals. In most practical cases this will be sufficiently accurate.

Valuation of serial bonds bearing semiannual dividends.—

The most common type of serial bond bears semiannual dividends and is redeemed in equal *annual* installments, the first of which is paid at the end of the first year. Formula (42) lends itself directly to the valuation of this bond at a nominal rate of interest j convertible twice a year. In this case $f=t=1$, $r=n$, and

$$k = \left[1 - \frac{a_{\overline{2n+2}|} - a_{\overline{2}|}}{na_{\overline{2}|}} \right] (g-j)/j \quad \text{at rate } j/2. \quad (49)$$

Formula (49) requires the use of a table of values of $a_{\overline{n}|}$ only. It can be put in another convenient form for computation involving the use of a table of values of $a_{\overline{n}|}$ and $s_{\overline{n}|}$. For, by formula (46), $a_{\overline{2+2n}|} = a_{\overline{2}|} + v^2 a_{\overline{2n}|}$, and, since $v^2/a_{\overline{2}|} = 1/(1+i)^2 a_{\overline{2}|} = 1/s_{\overline{2}|}$, after a simple reduction, there results

$$k = \left[1 - \frac{a_{\overline{2n}|}}{ns_{\overline{2}|}} \right] (g-j)/j \quad \text{at rate } j/2. \quad (50)$$

Example 23.—\$300,000 highway serial bonds bearing 4% interest payable semiannually, dated January 1, 1914, mature \$100,000 January 1, 1915, 1916, and 1917. What price should be paid to realize a net income of 3% compounded semiannually?

Here $n=3$, $g=.04$, $j_{(2)}=.03$, and by formula (49)

$$\begin{aligned}k &= \left[1 - \frac{a_{\overline{8}|} - a_{\overline{2}|}}{3a_{\overline{2}|}} \right] (.04-.03)/.03 \quad \text{at } 1\frac{1}{2}\% \\ &= .0575373 \times 1/3 = .0191791,\end{aligned}$$

therefore the price to earn 3% compounded semiannually is

$$1.0191791 \times \$300,000 = \$305,753.73.$$

The following schedule illustrates the progress of this loan.

$$52448^\circ - 15 - 8$$

SCHEDULE VI.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 1½%.	Semiannual dividend of 2% on bonds.	Amortization of premium at end of half-year.	Redemption payment at end of half-year.
$\frac{1}{2}$	\$305, 753. 73	\$4, 586. 31	\$6, 000. 00	\$1, 413. 69	0. 00
1	304, 340. 04	4, 565. 10	6, 000. 00	1, 434. 90	\$100, 000. 00
$1\frac{1}{2}$	202, 905. 14	3, 043. 58	4, 000. 00	956. 42	0. 00
2	201, 948. 72	3, 029. 23	4, 000. 00	970. 77	100, 000. 00
$2\frac{1}{2}$	100, 977. 95	1, 514. 67	2, 000. 00	485. 33	0. 00
3	100, 492. 62	1, 507. 38	2, 000. 00	492. 62	100, 000. 00
Totals	1, 216, 418. 20	18, 246. 27	24, 000. 00	5, 753. 73	300, 000. 00

Annuity bonds.—On pages 101 to 104 the operation of a loan where both principal and interest are discharged by equal installments is fully described. It is evident that bonds may be issued on this basis and retired in accordance with the principal repayments contained in the annuity installments. Since these principal repayments are not exact multiples of the amounts or denominations in which bonds are usually issued, it is necessary to adjust the *exact* schedule so as to meet this requirement. The adjusted schedule gives an issue in which the bonds are retired year by year in increasing amounts. Examples of exact and adjusted schedules appear in the body of this bulletin on pages 16 and 17.

To finance a loan of L by an issue of annuity bonds bearing interest or dividends at rate g per annum.—The annual installment which will retire the bonds in n years and at the same time pay interest at the rate of g per cent on outstanding bonds is

$$L/a_{\overline{n}|} \quad \text{at rate } g. \quad (51)$$

If the bonds are to bear interest of g per cent per annum, payable in p installments of g/p per cent during the year, then

$$L/a_{\overline{np}|} \quad \text{at rate } g/p \quad (52)$$

is the periodical payment or annuity installment which will take care of interest on the bonds and retire them in n years.

Example 24.—Adjust Schedule I, page 102, to finance the same loan by an annuity bond issue of \$100,000, denomination \$100, bearing 5% interest, compounded semi-annually, and retired in three years by six equal (nearly) semiannual annuity installments.

Referring to Schedule I on page 102, the adjustments in the last column to even multiples of \$100 are easily made; a check on this work is that the adjusted column must foot up to \$100,000. When the column of bond redemptions is decided upon, the other columns in the schedule are readily derived.

SCHEDULE VII.

(Schedule I adjusted to bonds of denomination \$100.)

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2½%.	Annuity installments at end of half-year.	Amortization of premium at end of half-year.	Amount of bonds retired at end of half-year.
$\frac{1}{2}$	\$100,000	\$2,500.00	\$18,200.00	0.00	\$15,700
1	84,300	2,107.50	18,107.50	0.00	16,000
$1\frac{1}{2}$	68,300	1,707.50	18,107.50	0.00	16,400
2	51,900	1,297.50	18,197.50	0.00	16,900
$2\frac{1}{2}$	35,000	875.00	18,175.00	0.00	17,300
3	17,700	442.50	18,142.50	0.00	17,700
Totals	357,200	8,930.00	108,930.00	0.00	100,000

Valuation of annuity bonds.—In order to value an issue of this character, so as to yield the purchaser a net income at a rate of interest different from the rate of dividend on the bonds, it will ordinarily be necessary to value separately the several parts of the total issue in accordance with the respective dates on which they are retired. This calculation may frequently be shortened by employing formula (36). Bond tables may also be consulted to advantage. The following example and schedule respectively illustrate the calculation of the bid and progress of the loan.

Example 25.—Determine the bid on the entire issue of annuity bonds in Example 24 so as to yield the investor a net income of 4%, compounded semiannually.

Applying formula (35) successively to the several bond issues in the order in which they are retired with $g=.05$ and $j=.04$, the following premiums are found:

\$76.96
155.32
236.48
321.75
407.71
495.73

\$1,693.95

Accordingly, the bid on the entire issue is \$101,693.95. The schedule illustrating the progress of this bond issue follows. It is constructed in the same manner as preceding bond schedules and needs no additional explanation.

SCHEDULE VIII.—*Showing the progress of an annuity bond issue of \$100,000, denomination \$100, bearing 5 per cent interest, compounded semiannually, and retired in three years by six equal (nearly) semiannual annuity installments. Bought to yield the investor 4 per cent, compounded semiannually.*

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Annuity installments at end of half-year.	Amortization of premium at end of half-year.	Amount of bonds retired at end of half-year.
$\frac{1}{2}$	\$101,693.95	\$2,033.88	\$18,200.00	\$466.12	\$15,700
1	85,527.83	1,710.56	18,107.50	396.94	16,000
$1\frac{1}{2}$	69,130.89	1,382.62	18,107.50	324.88	16,400
2	52,406.01	1,048.12	18,197.50	249.38	16,900
$2\frac{1}{2}$	35,256.63	705.13	18,175.00	169.87	17,300
3	17,786.76	355.74	18,142.50	86.76	17,700
Totals	361,802.07	7,236.05	108,930.00	1,693.95	100,000

TABLE 31.—*The accumulation of 1 at the end of n years.*

$$r^n = (1+i)^n.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0150000	1.0175000	1.0200000	1.0225000	1.0250000	1.0275000	1.0300000	1
2	1.0302250	1.0353063	1.0404000	1.0455063	1.0506250	1.0557563	1.0609000	2
3	1.0456784	1.0534241	1.0612080	1.0690301	1.0768906	1.0847896	1.0927270	3
4	1.0613636	1.0718590	1.0824322	1.0930833	1.1038129	1.1146213	1.1255088	4
5	1.0772840	1.0906166	1.1040808	1.1176777	1.1314082	1.1452733	1.1592741	5
6	1.0934433	1.1097024	1.1261624	1.1428254	1.1596934	1.1767684	1.1940523	6
7	1.1098449	1.1291222	1.1486857	1.1685390	1.1886858	1.2091295	1.2298739	7
8	1.1264926	1.1488818	1.1716594	1.1948311	1.2184029	1.2423806	1.2667701	8
9	1.1433900	1.1689872	1.1950926	1.2217148	1.2488630	1.2765460	1.3047732	9
10	1.1605408	1.1894445	1.2189944	1.2492034	1.2800845	1.3116510	1.3439164	10
11	1.1779489	1.2102598	1.2433743	1.2773105	1.3120867	1.3477214	1.3842339	11
12	1.1956182	1.2314393	1.2682418	1.3060500	1.3448888	1.3847838	1.4257609	12
13	1.2135524	1.2529895	1.2936066	1.3354361	1.3785110	1.4228653	1.4685337	13
14	1.2317557	1.2749168	1.3194788	1.3654834	1.4129738	1.4619941	1.5125088	14
15	1.2502321	1.2972279	1.3458683	1.3962068	1.4482982	1.5021990	1.5579674	15
16	1.2689856	1.3199294	1.3727857	1.4276215	1.4845056	1.5435094	1.6047064	16
17	1.2880203	1.3430281	1.4002414	1.4597429	1.5216183	1.5859560	1.6528476	17
18	1.3073406	1.3665311	1.4282463	1.4925872	1.5596587	1.6295697	1.7024331	18
19	1.3269508	1.3904454	1.4568112	1.5261704	1.5986502	1.6743829	1.7535061	19
20	1.3468550	1.4147782	1.4859474	1.5605092	1.6386164	1.7204284	1.8061112	20
21	1.3670578	1.4395368	1.5156663	1.5956207	1.6795819	1.7677402	1.8602946	21
22	1.3875637	1.4647287	1.5459797	1.6315221	1.7215714	1.8163531	1.9161034	22
23	1.4083772	1.4903615	1.5768993	1.6682314	1.7646107	1.8663028	1.9735865	23
24	1.4295028	1.5164428	1.6084373	1.7057666	1.8087260	1.9176261	2.0372941	24
25	1.4509454	1.5429805	1.6406060	1.7441463	1.8539441	1.9703608	2.0937779	25
26	1.4727095	1.5699827	1.6734181	1.7833896	1.9002927	2.0245458	2.1565913	26
27	1.4948023	1.5974574	1.7068865	1.8235159	1.9478000	2.0802208	2.2212890	27
28	1.5172222	1.6254129	1.7410242	1.8645450	1.9964950	2.1374268	2.2879277	28
29	1.5399805	1.6538576	1.7758447	1.9064973	2.0460742	2.1962601	2.3565655	29
30	1.5630802	1.6828001	1.8113616	1.9493934	2.0975676	2.2566017	2.4272625	30
31	1.5865264	1.7122491	1.8475888	1.9932548	2.1500068	2.3186583	2.5000804	31
32	1.6103243	1.7422135	1.8845406	2.0381030	2.2037569	2.3824214	2.5750828	32
33	1.6344792	1.7727022	1.9222314	2.0839603	2.2588509	2.4479380	2.6523352	33
34	1.6589964	1.8037245	1.9606760	2.1308495	2.3153221	2.5152563	2.7319053	34
35	1.6838813	1.8352897	1.9998896	2.1787936	2.3732052	2.5844258	2.8138625	35
36	1.7091395	1.8674073	2.0398873	2.2278164	2.4325353	2.6554975	2.8982783	36
37	1.7347766	1.9008069	2.0806851	2.2779423	2.4933487	2.7285237	2.9852267	37
38	1.7607983	1.9333384	2.1222988	2.3291960	2.5566824	2.8035581	3.0747835	38
39	1.7872103	1.9671718	2.1647448	2.3816029	2.6195745	2.8806560	3.1670270	39
40	1.8140184	2.0015973	2.2080397	2.4351890	2.6850638	2.9598740	3.2620378	40
41	1.8412287	2.0366253	2.2522005	2.4899807	2.7521904	3.0412705	3.3598989	41
42	1.8688471	2.0722662	2.2972445	2.5460053	2.8209952	3.1249055	3.4606959	42
43	1.8968798	2.1085309	2.3431894	2.6032904	2.8915201	3.2108404	3.5645168	43
44	1.9253330	2.1454302	2.3900531	2.6618644	2.9638081	3.2991385	3.6714523	44
45	1.9542130	2.1829732	2.4378542	2.7217564	3.0379033	3.3898648	3.7815958	45
46	1.9835262	2.2211773	2.4866113	2.7829959	3.1138509	3.4830861	3.8950437	46
47	2.0132791	2.2600479	2.5363435	2.8456133	3.1916971	3.5788709	4.0118950	47
48	2.0434783	2.2995987	2.5870704	2.9096396	3.2714896	3.6772899	4.1322519	48
49	2.0741305	2.3398417	2.6388118	2.9751065	3.3532768	3.7784154	4.2562194	49
50	2.1052424	2.3807589	2.6915880	3.0420464	3.4371087	3.8823218	4.3839060	50
51	2.1368211	2.4224527	2.7454198	3.1104924	3.5230364	3.9890856	4.5154232	51
52	2.1688734	2.4648457	2.8003282	3.1804785	3.6111124	4.0987855	4.6508859	52
53	2.2014065	2.5079805	2.8563348	3.2520393	3.7013902	4.2115021	4.7904125	53
54	2.2344276	2.5518701	2.9134614	3.3252102	3.7939249	4.3273184	4.9341249	54
55	2.2679440	2.5965279	2.9717307	3.4000274	3.8887730	4.4463196	5.0821486	55
56	2.3019631	2.6419671	3.0311653	3.4765280	3.9859924	4.5685934	5.2346131	56
57	2.3364926	2.6882015	3.0917886	3.5547499	4.0856422	4.6942298	5.3916514	57
58	2.3715400	2.7352450	3.1566244	3.6347318	4.1877832	4.8233211	5.5534010	58
59	2.4071131	2.7831163	3.2166969	3.7165132	4.2924778	4.9559624	5.7200030	59
60	2.4432198	2.8318163	3.2810308	3.8001348	4.3997897	5.0922514	5.8916031	60

TABLE 31.—*The accumulation of 1 at the end of n years—Continued.*

$$1^n = (1+i)^n.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	1.0350000	1.0400000	1.0450000	1.0500000	1.0550000	1.0600000	1.0700000	1
2	1.0712250	1.0816000	1.0920250	1.1025000	1.1130250	1.1236000	1.1449000	2
3	1.1087179	1.1248640	1.1411661	1.1576250	1.1742414	1.1910160	1.2250430	3
4	1.1475230	1.1698586	1.1925186	1.2155063	1.2388247	1.2624770	1.3107960	4
5	1.1876863	1.2166529	1.2461819	1.2762816	1.3069600	1.3382256	1.4025517	5
6	1.2292553	1.2653190	1.3022601	1.3400956	1.3788428	1.4185191	1.5007304	6
7	1.2722793	1.3159318	1.3608618	1.4071004	1.4546792	1.5036303	1.6057815	7
8	1.3168090	1.3685691	1.4221006	1.4774354	1.5346865	1.5938481	1.7181862	8
9	1.3628974	1.4233118	1.4860951	1.5513282	1.6190943	1.6894790	1.8384592	9
10	1.4105988	1.4802443	1.5529694	1.6288946	1.7081445	1.7908477	1.9671514	10
11	1.4599697	1.5394541	1.6228531	1.7103394	1.8020924	1.8982986	2.1048520	11
12	1.5110687	1.6010322	1.6958814	1.7958563	1.9012075	2.0121965	2.2521916	12
13	1.5639561	1.6650735	1.7721961	1.8856491	2.0057739	2.1239283	2.4098450	13
14	1.6186945	1.7316765	1.8519449	1.9799316	2.1160915	2.2609040	2.5785342	14
15	1.6753488	1.8009435	1.9352824	2.0789282	2.2324765	2.3965582	2.7590315	15
16	1.7339860	1.8729813	2.0223702	2.1828746	2.3552627	2.5403517	2.9521638	16
17	1.7946756	1.9473005	2.1133768	2.2920183	2.4848022	2.6927728	3.1588152	17
18	1.8574892	2.0258165	2.2084788	2.4066192	2.6214663	2.8543392	3.3799323	18
19	1.9225013	2.1068492	2.3078603	2.5269502	2.7656469	3.0255995	3.6165275	19
20	1.9897889	2.1911231	2.4117140	2.6532977	2.9177575	3.2071355	3.8696845	20
21	2.0594315	2.2787681	2.5202412	2.7859626	3.0782342	3.3995636	4.1405624	21
22	2.1315116	2.3699188	2.6336520	2.9252607	3.2475370	3.6035374	4.4304017	22
23	2.2061145	2.4647155	2.7521664	3.0715238	3.4261516	3.8197497	4.7405299	23
24	2.2833285	2.5633042	2.8760138	3.2250999	3.6145899	4.0489346	5.0723670	24
25	2.3632450	2.6658363	3.0054345	3.3863549	3.8133924	4.2918707	5.4274326	25
26	2.4459586	2.7724698	3.1406790	3.5556727	4.0231289	4.5493830	5.8073529	26
27	2.5315671	2.8836688	3.2820096	3.7334563	4.2444010	4.8223459	6.2138676	27
28	2.6201720	2.9987033	3.4297000	3.9201291	4.4778431	5.1116867	6.6488384	28
29	2.7118780	3.1186515	3.5840365	4.1161356	4.7241244	5.4183879	7.1142571	29
30	2.8067937	3.2433975	3.7453181	4.3219424	4.9839513	5.7349192	7.6122550	30
31	2.9050315	3.3731334	3.9138575	4.5380395	5.2580686	6.0881006	8.1451129	31
32	3.0067076	3.5085888	4.0899810	4.7649415	5.5472624	6.4533637	8.7152708	32
33	3.1119424	3.6488311	4.2740302	5.0031885	5.8523618	6.8405899	9.3253398	33
34	3.2208603	3.7943163	4.4663615	5.2533480	6.1742417	7.2510253	9.9781135	34
35	3.3335905	3.9460890	4.6673478	5.5160154	6.5138250	7.6860688	10.6765815	35
36	3.4502661	4.1039226	4.8777875	5.7918161	6.8720854	8.1472520	11.4239422	36
37	3.5710254	4.2680899	5.0968605	6.0814069	7.2500501	8.6360871	12.2236181	37
38	3.6960113	4.4388135	5.3262192	6.3854773	7.6488028	9.1542524	13.0792714	38
39	3.8253717	4.6163660	5.5658991	6.7047512	8.0694870	9.7035075	13.9948204	39
40	3.9592597	4.8010206	5.8163645	7.0399887	8.5133088	10.2857179	14.9744578	40
41	4.0978338	4.9930615	6.0781009	7.3919882	8.9815408	10.9028610	16.0226699	41
42	4.24112580	5.1927839	6.3516155	7.7615876	9.4755255	11.5570327	17.1442568	42
43	4.3897020	5.4004953	6.6374382	8.1496669	9.9966794	12.2504546	18.3443548	43
44	4.5433416	5.6165151	6.9361229	8.5571503	10.5464968	12.9854819	19.6284596	44
45	4.7023586	5.8411757	7.2482484	8.9850078	11.1265541	13.7646108	21.0024518	45
46	4.8669411	6.0748227	7.5744196	9.4342582	11.7385146	14.5904875	22.4726234	46
47	5.0372840	6.3178156	7.9152685	9.9059711	12.3841329	15.4659167	24.0457070	47
48	5.2135890	6.5705282	8.2714556	10.4012697	13.0652602	16.3938717	25.7289065	48
49	5.3960646	6.8333494	8.6436711	10.9213331	13.7838495	17.3775040	27.5299300	49
50	5.5849269	7.1066834	9.0326363	11.4673998	14.5419612	18.4201543	29.4570251	50
51	5.7803993	7.3909507	9.4391049	12.0407698	15.3417691	19.5253635	31.5190168	51
52	5.9827133	7.6855887	9.8638664	12.6428083	16.1855664	20.6968853	33.7253480	52
53	6.1921082	7.9940523	10.3077385	13.2749487	17.0757725	21.9368985	36.0861224	53
54	6.4083820	8.3138144	10.7715868	13.9386961	18.0149400	23.2550204	38.6121509	54
55	6.6331411	8.6463669	11.2563082	14.6356309	19.0057617	24.6503216	41.3150015	55
56	6.8653011	8.9922216	11.7628420	15.3674125	20.0510786	26.1293409	44.2070516	56
57	7.1055866	9.3519105	12.2921699	16.1357831	21.1338879	27.6971013	47.3015452	57
58	7.3542822	9.7259869	12.8453176	16.9425722	22.3173518	29.3589274	50.6126354	58
59	7.6116820	10.1150264	13.4233569	17.7897009	23.5448061	31.1204631	54.1555391	59
60	7.8780909	10.5196274	14.0274079	18.6971859	24.8397705	32.9876909	57.9464268	60

TABLE 32.—*The accumulation of an annuity of 1 per annum at the end of n years.*

$$s_n = \frac{(1+i)^n - 1}{i}$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	2.0159000	2.0175000	2.0200000	2.0225000	2.0250000	2.0275000	2.0300000	2
3	3.0452250	3.0528063	3.0604000	3.0680063	3.0756250	3.0832563	3.0909000	3
4	4.0909034	4.1062304	4.1216080	4.1370364	4.1525156	4.1680458	4.1836270	4
5	5.1522669	5.1780894	5.2040402	5.2301197	5.2563285	5.2826671	5.3091358	5
6	6.2295509	6.2687069	6.3081210	6.3477974	6.3877367	6.4279404	6.4684099	6
7	7.3229942	7.3784083	7.4342834	7.4906228	7.5474302	7.6047088	7.6624622	7
8	8.4328391	8.5075305	8.5829691	8.6591619	8.7361159	8.8138383	8.8923361	8
9	9.5593317	9.6541122	9.7546284	9.8539930	9.9545188	10.0562188	10.1591061	9
10	10.7027217	10.8253995	10.9497210	11.0757078	11.2033818	11.3327648	11.4638793	10
11	11.8632625	12.0148439	12.1687154	12.3249113	12.4834663	12.6444159	12.8077957	11
12	13.0412114	13.2251037	13.4120897	13.6022218	13.7955538	13.9921373	14.1920266	12
13	14.2368296	14.4565430	14.6803315	14.9082718	15.1404418	15.3769211	15.6177905	13
14	15.4503821	15.7095325	15.9739382	16.2437079	16.5189528	16.7997864	17.0863242	14
15	16.6821378	16.9844494	17.2931969	17.6091927	17.9319267	18.2617805	18.5998139	15
16	17.9323698	18.2816772	18.6392853	19.0053981	19.3802248	19.7639795	20.1568813	16
17	19.2013554	19.6016066	20.0120710	20.4330196	20.8647305	21.3074889	21.7615877	17
18	20.4893757	20.9463447	21.4123124	21.8927625	22.3863487	22.8934449	23.4144354	18
19	21.7967164	22.3111658	22.8405586	23.3853497	23.9460074	24.5230146	25.1168654	19
20	23.1202721	23.7016112	24.2973698	24.9115200	25.5446576	26.1973975	26.8703745	20
21	24.4705221	25.1163894	25.7833172	26.4720292	27.1832741	27.9178259	28.6764857	21
22	25.8375799	26.5559262	27.2989835	28.0676499	28.8628559	29.6855662	30.5367803	22
23	27.2251436	28.0265499	28.8496322	29.6991720	30.5844273	31.5019192	32.4528837	23
24	28.6335208	29.5110164	30.4218625	31.3671034	32.3490380	33.3682220	34.4264702	24
25	30.0630236	31.0274592	32.0302997	33.0731700	34.1577639	35.2858481	36.4592643	25
26	31.5139690	32.5704397	33.6709057	34.8173163	36.0117080	37.2562089	38.5530423	26
27	32.9866785	34.1404224	35.3443238	36.6007059	37.9120007	39.2807547	40.7096335	27
28	34.4814787	35.7378798	37.0512103	38.4242218	39.8598008	41.3602954	42.9309225	28
29	35.9987009	37.3632927	38.7292345	40.2887668	41.8562958	43.4984022	45.2185502	29
30	37.5386814	39.0171503	40.5680792	42.1952640	43.9027032	45.6946083	47.5754157	30
31	39.1017616	40.699504	42.3794408	44.1446575	46.0002707	47.9512100	50.0026782	31
32	40.6882880	42.411996	44.2270296	46.1379123	48.1502775	50.2698683	52.5027585	32
33	42.2986123	44.154131	46.115702	48.1760153	50.3540345	52.6529502	55.0778413	33
34	43.9330915	45.9271153	48.038016	50.2599756	52.6128553	55.1002277	57.7301765	34
35	45.6320579	47.7803898	49.9944776	52.3908251	54.9282074	57.6154839	60.4621081	35
36	47.3759692	49.5661295	51.9943672	54.5696186	57.3014126	60.1999097	63.2759443	36
37	48.9851087	51.4335368	54.0342545	56.7974351	59.7339479	62.8554072	66.1742226	37
38	50.7198854	53.3336236	56.119396	59.0753774	62.227966	65.5839309	69.1591493	38
39	52.4806837	55.2666221	58.2372384	61.4045733	64.7829791	68.3874890	72.2432329	39
40	54.2678939	57.2341339	60.4019832	63.7861762	67.4025532	71.2681450	75.4012597	40
41	56.0819123	59.2357312	62.6100228	66.2213652	70.0876174	74.2280190	78.6632975	41
42	57.9231410	61.2723565	64.8622233	68.7113459	72.8398078	77.2692895	82.0231965	42
43	59.7910881	63.3446228	67.1594678	71.2573512	75.6608030	80.391950	85.4838923	43
44	61.6888679	65.4531537	69.5026571	73.8606416	78.5523231	83.6050353	89.0484091	44
45	63.6142010	67.5985839	71.8927103	76.5225061	81.5161312	86.9041738	92.7198614	45
46	65.5684140	69.7815591	74.3305645	79.2442624	84.5540344	90.2940386	96.5014572	46
47	67.5519402	72.0027364	76.8117158	82.0272583	87.6678853	93.771246	100.3965010	47
48	69.5652193	74.2627843	79.3535193	84.8728717	90.8595824	97.3559564	104.4039660	48
49	71.6089676	76.5623830	81.9405897	87.7825113	94.1310720	101.0382854	108.5406479	49
50	73.6828280	78.9022247	84.5794015	90.7576175	97.4843488	104.8117008	112.7968673	50
51	75.7880705	81.2830136	87.2709895	93.7996642	100.9214575	108.6940226	117.1807733	51
52	77.9248915	83.7054664	90.0164093	96.9101566	104.444940	112.6831082	121.6961965	52
53	80.0937649	86.1703120	92.8167372	100.0906351	108.0556063	116.7818937	126.3470824	53
54	82.2951714	88.6782925	95.6730723	103.3426744	111.7569963	120.9933957	131.1374949	54
55	84.5295939	91.2301626	98.5865337	106.6678846	115.5509214	125.3207141	136.0716197	55
56	86.7975429	93.8266904	101.5582643	110.0679120	119.4396944	129.7670338	141.1537683	56
57	89.0995061	96.4686575	104.5894296	113.5444400	123.4256865	134.3356272	146.3883814	57
58	91.4335987	99.1585990	107.6812182	117.0991899	127.5113289	139.0295859	151.7900238	58
59	93.8075386	101.8921041	110.8348126	120.7339217	131.6991122	143.8531780	157.3334338	59
60	96.2146517	104.6752159	114.0515394	124.4504349	135.9915900	148.8091404	163.0534368	60

TABLE 32.—*The accumulation of an annuity of 1 per annum at the end of n years—Con.*

$$s_n = \frac{(1+i)^n - 1}{i}$$

Yrs.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Yrs.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	2.0350000	2.0400000	2.0450000	2.0500000	2.0550000	2.0600000	2.0700000	2
3	3.1062250	3.1216000	3.1370250	3.1525000	3.1680250	3.1836000	3.2149000	3
4	4.2149429	4.2464640	4.2781911	4.3101250	4.3422664	4.3746160	4.4399430	4
5	5.3624659	5.4163226	5.4707097	5.5256313	5.5810910	5.6370930	5.7507390	5
6	6.5501522	6.6329755	6.7168917	6.8019128	6.8880510	6.9753185	7.1532907	6
7	7.7794075	7.8982945	8.0191518	8.1420085	8.2668938	8.3938377	8.6540211	7
8	9.0516868	9.2142263	9.3800136	9.5491089	9.7215790	9.8974730	10.2598026	8
9	10.3684958	10.5827953	10.8021142	11.0265643	11.2562595	11.4913160	11.9798889	9
10	11.7313932	12.0061071	12.2882094	12.5778925	12.8735358	13.1807949	13.8164480	10
11	13.1419919	13.4863514	13.8411788	14.2067872	14.5834983	14.9716426	15.7835993	11
12	14.6019616	15.0258055	15.4640318	15.9171265	16.3855907	16.8699412	17.8884513	12
13	16.1130303	16.6208377	17.1599133	17.7129829	18.2867981	18.8821377	20.1406429	13
14	17.6769864	18.2919112	18.9321094	19.5986320	20.2925720	21.0150659	22.5504879	14
15	19.2956809	20.0235876	20.7840543	21.5785636	22.4086625	23.2759699	25.1290220	15
16	20.9710297	21.8245311	22.7193367	23.6574918	24.6411400	25.6725281	27.8880536	16
17	22.7051518	23.6975124	24.7417069	25.8403664	26.9964027	28.2128798	30.8402173	17
18	24.4969113	25.6454129	26.8550837	28.1323847	29.4812048	30.9056526	33.9909325	18
19	26.3571805	27.6712294	29.0635625	30.5390039	32.1026711	33.7599917	37.3789648	19
20	28.2796818	29.7780786	31.3714228	33.0659541	34.8683180	36.7855912	40.9954923	20
21	30.2694707	31.9692017	33.7831368	35.7192518	37.7860755	39.9927267	44.8651768	21
22	32.3289022	34.2479698	36.3033780	38.5052144	40.8643097	43.3922903	49.0057392	22
23	34.4604137	36.6178886	38.9370300	41.4304751	44.1118467	46.9958277	53.4361409	23
24	36.6665282	39.0826041	41.6891963	44.5019989	47.5379983	50.8155774	58.1766708	24
25	38.9498567	41.6459083	44.5652102	47.7270988	51.1525882	54.8645120	63.2490377	25
26	41.3131017	44.3117446	47.5706446	51.1134538	54.9659804	59.1563827	68.6764704	26
27	43.7590602	47.0842144	50.7113236	54.6691265	58.9891095	63.7057657	74.4882333	27
28	46.2906273	49.9675830	53.9933332	58.4025828	63.235105	68.5281116	80.6979099	28
29	48.9107993	52.9662863	57.4230332	62.3227119	67.7113535	73.6397983	87.3465798	29
30	51.6226773	56.0849378	61.0070697	66.4388475	72.4354780	79.0581862	94.4607863	30
31	54.4294710	59.3283353	64.7523873	70.7607899	77.4194293	84.8016774	102.0730414	31
32	57.3345025	62.7014687	68.6662452	75.2988294	82.677479	90.8897780	110.2181543	32
33	60.3412101	66.2095274	72.7562263	80.0637708	88.2247603	97.3431647	118.9334251	33
34	63.4531524	69.8579085	77.0302565	85.0669594	94.0771221	104.1837546	128.2587648	34
35	66.6740127	73.6522249	81.4966180	90.3203074	100.2513638	111.4347799	138.2368784	35
36	70.0076032	77.5983139	86.1639658	95.8363227	106.7651888	119.1208667	148.9134598	36
37	73.4578693	81.7022464	91.0413443	101.6281389	113.6372742	127.2681187	160.3374020	37
38	77.0288947	86.9703363	96.1382048	107.7095458	120.8873243	135.9042058	172.5610202	38
39	80.7249060	90.4091497	101.4644240	114.0950231	128.5361271	145.0584581	185.6402916	39
40	84.5502778	95.0255157	107.0303231	120.7997742	136.0056141	154.7619656	199.6351120	40
41	88.5095375	99.8265363	112.8466876	127.8397630	145.1189229	165.0476836	214.6095698	41
42	92.6073713	104.8195978	118.9247885	135.2317511	154.1004636	175.9505446	230.6223927	42
43	96.8486293	110.0123817	125.2764040	142.9933387	163.5759891	187.5075772	247.7764695	43
44	101.2383313	115.4128770	131.9138422	151.1430056	173.5726685	199.7580319	266.1208513	44
45	105.7816729	121.0293920	138.8499651	159.7001559	184.1191653	212.7435138	285.7493108	45
46	110.4840315	126.8705677	146.0982135	168.6851637	195.2457194	226.5081246	306.7517626	46
47	115.3509726	132.9453904	153.6726331	178.1194219	206.9842339	241.0986121	329.2240360	47
48	120.3882566	139.2632060	161.5879016	188.0253929	219.3683668	256.5645288	353.2700930	48
49	125.6018456	145.8337343	169.8593572	198.4266626	232.4336270	272.9584006	378.9989995	49
50	130.9979102	152.6670837	178.5083023	209.3479957	246.2174765	290.3359046	406.5289295	50
51	136.5828370	159.7737670	187.5356646	220.8153955	260.7594377	308.7560589	435.9859545	51
52	142.3632363	167.1647177	196.9747695	232.8561653	276.1012067	328.2814224	467.5049714	52
53	148.3459496	174.8513064	206.8363491	245.4989731	292.2867731	348.9783077	501.2303194	53
54	154.5380578	182.8455387	217.1463726	258.7739222	309.3625456	370.9170062	537.3164417	54
55	160.9468898	191.1591730	227.9179594	272.7126183	327.3774856	394.1720266	575.9285926	55
56	167.5800310	199.8055399	239.1742676	287.3482492	346.3832472	418.8223482	617.2435941	56
57	174.4453321	208.7977615	250.9371096	302.7156617	366.443259	444.9516891	661.4506457	57
58	181.5509187	218.1496720	263.2292795	318.8514448	387.5882139	472.6487904	708.7521909	58
59	188.9052009	227.8756589	276.0715971	335.7940170	409.9055656	502.0077178	759.3648443	59
60	196.5168829	237.9906852	289.4979540	353.5837179	433.4503717	533.1281809	813.5203834	60

TABLE 33.—*The annual sinking fund which will accumulate to 1 at the end of n years.*

$$\frac{1}{s_n} = \frac{i}{(1+i)^n - 1}$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	0.4962779	0.4956630	0.4950495	0.4944376	0.4938272	0.4932183	0.4926108	2
3	0.3283830	0.3275675	0.3267547	0.3259446	0.3251372	0.3243324	0.3235304	3
4	0.2444448	0.2435581	0.2426238	0.2417189	0.2408179	0.2399206	0.2390271	4
5	0.1940893	0.1931214	0.1921584	0.1912002	0.1902469	0.1892983	0.1883546	5
6	0.1605252	0.1595262	0.1585258	0.1575350	0.1565500	0.1555708	0.1545975	6
7	0.1365562	0.1355506	0.1345120	0.1335003	0.1324954	0.1314975	0.1305064	7
8	0.1185840	0.1175429	0.1165098	0.1154846	0.1144674	0.1134580	0.1124564	8
9	0.1046098	0.1035581	0.1025154	0.1014817	0.1004569	0.0994410	0.0984339	9
10	0.0934342	0.0923753	0.0913265	0.0902877	0.0892588	0.0882397	0.0872305	10
11	0.0842938	0.0832304	0.0821779	0.0811365	0.0801060	0.0790863	0.0780775	11
12	0.0766800	0.0756138	0.0745596	0.0735174	0.0724871	0.0714687	0.0704621	12
13	0.0702404	0.0691728	0.0681184	0.0670769	0.0660483	0.0650325	0.0640295	13
14	0.0647233	0.0636556	0.0626020	0.0615623	0.0605365	0.0595246	0.0585263	14
15	0.0599444	0.0588774	0.0578255	0.0567885	0.0557665	0.0547592	0.0537666	15
16	0.0557651	0.0546996	0.0536501	0.0526166	0.0515990	0.0505971	0.0496109	16
17	0.0520797	0.0510162	0.0499698	0.0489404	0.0479278	0.0469319	0.0459525	17
18	0.0488058	0.0477449	0.0467021	0.0456772	0.0446701	0.0436806	0.0427087	18
19	0.0458785	0.0448206	0.0437818	0.0427618	0.0417606	0.0407780	0.0398139	19
20	0.0432457	0.0421912	0.0411567	0.0401421	0.0391471	0.0381717	0.0372157	20
21	0.0408655	0.0398146	0.0387848	0.0377757	0.0367873	0.0358194	0.0348718	21
22	0.0387033	0.0376564	0.0366314	0.0356282	0.0346466	0.0336864	0.0327474	22
23	0.0367308	0.0356878	0.0346681	0.0336710	0.0326964	0.0317441	0.0308139	23
24	0.0349241	0.0338857	0.0328711	0.0318802	0.0309128	0.0299684	0.0290474	24
25	0.0332635	0.0322295	0.0312204	0.0302360	0.0292759	0.0283400	0.0274279	25
26	0.0317320	0.0307027	0.0296992	0.0287213	0.0277687	0.0268412	0.0259383	26
27	0.0303153	0.0292908	0.0282931	0.0273219	0.0263769	0.0254578	0.0245642	27
28	0.0290011	0.0279815	0.0269897	0.0260253	0.0250879	0.0241774	0.0232932	28
29	0.0277788	0.0267642	0.0257784	0.0248208	0.0238913	0.0229894	0.0221147	29
30	0.0266632	0.0256528	0.0246499	0.0236993	0.0227776	0.0218844	0.0210193	30
31	0.0255743	0.0245701	0.0235964	0.0226528	0.0217390	0.0208545	0.0199989	31
32	0.0245771	0.0235731	0.0226106	0.0216742	0.0207683	0.0198926	0.0190466	32
33	0.0236414	0.0226378	0.0216865	0.0207572	0.0198594	0.0189925	0.0181561	33
34	0.0227619	0.0217576	0.0208187	0.0198966	0.0190068	0.0181488	0.0173220	34
35	0.0219336	0.0209290	0.0200022	0.0190873	0.0182056	0.0173565	0.0165393	35
36	0.0211524	0.0201475	0.0192329	0.0183252	0.0174516	0.0166113	0.0158038	36
37	0.0204144	0.0194096	0.0185068	0.0176064	0.0167409	0.0159095	0.0151116	37
38	0.0197161	0.0187119	0.0178206	0.0169275	0.0160701	0.0152476	0.0144593	38
39	0.0190546	0.0180504	0.0171711	0.0162854	0.0154362	0.0146226	0.0138439	39
40	0.0184271	0.0174231	0.0165558	0.0156774	0.0148362	0.0140315	0.0132624	40
41	0.0178311	0.0168271	0.0159219	0.0151009	0.0142679	0.0134720	0.0127124	41
42	0.0172643	0.0162603	0.0153553	0.0145336	0.0137288	0.0129418	0.0121917	42
43	0.0167247	0.0157207	0.0148159	0.0140036	0.0132169	0.0124387	0.0116681	43
44	0.0162104	0.0152064	0.0143017	0.0134899	0.0127030	0.0119610	0.0112298	44
45	0.0157198	0.0147158	0.0138096	0.0130061	0.0122675	0.0115069	0.0107852	45
46	0.0152512	0.0142472	0.0133434	0.0125399	0.0117469	0.0110049	0.0102832	46
47	0.0148034	0.0137994	0.0128956	0.0120921	0.0112991	0.0105166	0.0097950	47
48	0.0143750	0.0133710	0.0124672	0.0116637	0.0108707	0.0100882	0.0093666	48
49	0.0139648	0.0129608	0.0120570	0.0112535	0.0104605	0.0096780	0.0089564	49
50	0.0135717	0.0125677	0.0116639	0.0108604	0.0100674	0.0092849	0.0085633	50
51	0.0131947	0.0121907	0.0112869	0.0104834	0.0096904	0.0089079	0.0081863	51
52	0.0128329	0.0118289	0.0109251	0.0101216	0.0093286	0.0085461	0.0078245	52
53	0.0124854	0.0114814	0.0105776	0.0097741	0.0089811	0.0081986	0.0074770	53
54	0.0121514	0.0111474	0.0102436	0.0094401	0.0086471	0.0078646	0.0071430	54
55	0.0118302	0.0108262	0.0099224	0.0091189	0.0083259	0.0075434	0.0068218	55
56	0.0115211	0.0105171	0.0096133	0.0088103	0.0080173	0.0072348	0.0065132	56
57	0.0112234	0.0102194	0.0093156	0.0085126	0.0077196	0.0069371	0.0062155	57
58	0.0109366	0.0100326	0.0091288	0.0083258	0.0075328	0.0067503	0.0060287	58
59	0.0106601	0.0097561	0.0088523	0.0080493	0.0072563	0.0064738	0.0057522	59
60	0.0103934	0.0094894	0.0085856	0.0077826	0.0069796	0.0061971	0.0054755	60

TABLE 33.—*The annual sinking fund which will accumulate to 1 at the end of n years—Continued.*

$$\frac{1}{sn} = \frac{i}{(1+i)^n - 1}$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	0.4914005	0.4901961	0.4889976	0.4878049	0.4866180	0.4854369	0.4830918	2
3	0.3219342	0.3203485	0.3187734	0.3172086	0.3156541	0.3141098	0.3110517	3
4	0.2372511	0.2354901	0.2337437	0.2320118	0.2302945	0.2285915	0.2252281	4
5	0.1864814	0.1846271	0.1827916	0.1809748	0.1791764	0.1773964	0.1738907	5
6	0.1526682	0.1507619	0.1488784	0.1470175	0.1451790	0.1433626	0.1397958	6
7	0.1285445	0.1266096	0.1247015	0.1228198	0.1209644	0.1191350	0.1155532	7
8	0.1104767	0.1085278	0.1066097	0.1047218	0.1028640	0.1010359	0.0974678	8
9	0.0964460	0.0944930	0.0925745	0.0906901	0.0888395	0.0870222	0.0834865	9
10	0.0852414	0.0832909	0.0813788	0.0795046	0.0776678	0.0758680	0.0723775	10
11	0.0760920	0.0741490	0.0722482	0.0703889	0.0685707	0.0667929	0.0633569	11
12	0.0684840	0.0665522	0.0646662	0.0628254	0.0610292	0.0592770	0.0559020	12
13	0.0620616	0.0601437	0.0582754	0.0564558	0.0546843	0.0529601	0.0496509	13
14	0.0565707	0.0546690	0.0528203	0.0510240	0.0492791	0.0475849	0.0443449	14
15	0.0518251	0.0499411	0.0481138	0.0463423	0.0446256	0.0429628	0.0397946	15
16	0.0476848	0.0458200	0.0440154	0.0422699	0.0405825	0.0389521	0.0358577	16
17	0.0440431	0.0421985	0.0404176	0.0386991	0.0370420	0.0354448	0.0324252	17
18	0.0408158	0.0389933	0.0372369	0.0355462	0.0339199	0.0323565	0.0294126	18
19	0.0379403	0.0361386	0.0344073	0.0327450	0.0311501	0.0296209	0.0267530	19
20	0.0353611	0.0335818	0.0318761	0.0302426	0.0286793	0.0271846	0.0243929	20
21	0.0330366	0.0312801	0.0296006	0.0279961	0.0264648	0.0250046	0.0222890	21
22	0.0309321	0.0291988	0.0275457	0.0259705	0.0244712	0.0230456	0.0204058	22
23	0.0290188	0.0273091	0.0256825	0.0241368	0.0226696	0.0212785	0.0187139	23
24	0.0272728	0.0255868	0.0239870	0.0224709	0.0210358	0.0196790	0.0171890	24
25	0.0256740	0.0240120	0.0224390	0.0209525	0.0195494	0.0182267	0.0158105	25
26	0.0242054	0.0225674	0.0210214	0.0195643	0.0181931	0.0169044	0.0145610	26
27	0.0228524	0.0212385	0.0197195	0.0182919	0.0169523	0.0156972	0.0134257	27
28	0.0216027	0.0200130	0.0185208	0.0171225	0.0158144	0.0145926	0.0123919	28
29	0.0204454	0.0188799	0.0174146	0.0160455	0.0147686	0.0135796	0.0114487	29
30	0.0193713	0.0178301	0.0163915	0.0150514	0.0138054	0.0126489	0.0105864	30
31	0.0183724	0.0168554	0.0154435	0.0141321	0.0129167	0.0117922	0.0097969	31
32	0.0174415	0.0159486	0.0145632	0.0132804	0.0120952	0.0110023	0.0090729	32
33	0.0165724	0.0151036	0.0137445	0.0124900	0.0113347	0.0102729	0.0084081	33
34	0.0157597	0.0143148	0.0129819	0.0117554	0.0106296	0.0095984	0.0077967	34
35	0.0149984	0.0135773	0.0122705	0.0110717	0.0099749	0.0089739	0.0072340	35
36	0.0142842	0.0128869	0.0116058	0.0104345	0.0093664	0.0083948	0.0067153	36
37	0.0136133	0.0122396	0.0109840	0.0098398	0.0087999	0.0078574	0.0062369	37
38	0.0129821	0.0116319	0.0104017	0.0092842	0.0082722	0.0073581	0.0057951	38
39	0.0123878	0.0110608	0.0098557	0.0087646	0.0077799	0.0068938	0.0053865	39
40	0.0118273	0.0105235	0.0093432	0.0082782	0.0073203	0.0064615	0.0050091	40
41	0.0112982	0.0100174	0.0088616	0.0078223	0.0068909	0.0060589	0.0046596	41
42	0.0107983	0.0095402	0.0084087	0.0073947	0.0064893	0.0056634	0.0043359	42
43	0.0103254	0.0090899	0.0079824	0.0069933	0.0061134	0.0053331	0.0040359	43
44	0.0098777	0.0086645	0.0075807	0.0066163	0.0057613	0.0050061	0.0037577	44
45	0.0094534	0.0082625	0.0072020	0.0062617	0.0054313	0.0047005	0.0034996	45
46	0.0090511	0.0078821	0.0068447	0.0059282	0.0051218	0.0044149	0.0032600	46
47	0.0086692	0.0075219	0.0065073	0.0056142	0.0048313	0.0041477	0.0030374	47
48	0.0083065	0.0071807	0.0061886	0.0053184	0.0045555	0.0038977	0.0028307	48
49	0.0079617	0.0068571	0.0058872	0.0050397	0.0043023	0.0036636	0.0026385	49
50	0.0076337	0.0065502	0.0056022	0.0047767	0.0040615	0.0034443	0.0024599	50
51	0.0073216	0.0062589	0.0053323	0.0045287	0.0038350	0.0032388	0.0022937	51
52	0.0070243	0.0059821	0.0050768	0.0042945	0.0036219	0.0030462	0.0021390	52
53	0.0067410	0.0057192	0.0048347	0.0040733	0.0034213	0.0028565	0.0019951	53
54	0.0064709	0.0054691	0.0046052	0.0038644	0.0032325	0.0026960	0.0018611	54
55	0.0062132	0.0052312	0.0043875	0.0036669	0.0030356	0.0025370	0.0017363	55
56	0.0059673	0.0050049	0.0041811	0.0034801	0.0028870	0.0023877	0.0016201	56
57	0.0057325	0.0047893	0.0039851	0.0033034	0.0027290	0.0022247	0.0015118	57
58	0.0055081	0.0045504	0.0037990	0.0031363	0.0025801	0.0021157	0.0014109	58
59	0.0052937	0.0043884	0.0036222	0.0029780	0.0024396	0.0019920	0.0013169	59
60	0.0050886	0.0042019	0.0034543	0.0028282	0.0023071	0.0018757	0.0012292	60

TABLE 34.—*The present value of 1 due in n years.*

$$v^n = (1+i)^{-n}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	0.9852217	0.9828010	0.9803922	0.9779951	0.9756098	0.9732360	0.9708738	1
2	0.9706618	0.9658978	0.9611688	0.9564744	0.9518144	0.9471883	0.9425959	2
3	0.9563170	0.9492853	0.9423223	0.9354273	0.9285994	0.9218378	0.9151417	3
4	0.9421842	0.9329585	0.9238454	0.9148434	0.9059506	0.8971657	0.8884871	4
5	0.9282603	0.9169125	0.9057308	0.8947123	0.8838543	0.8731540	0.8626088	5
6	0.9145422	0.9011425	0.8879714	0.8750243	0.8622969	0.8497849	0.8374843	6
7	0.9010268	0.8856438	0.8705602	0.8557695	0.8412652	0.8270413	0.8130915	7
8	0.8877111	0.8704116	0.8534904	0.8369384	0.8207466	0.8049064	0.7894092	8
9	0.8745922	0.8554414	0.8367553	0.8185216	0.8007284	0.7836539	0.7664167	9
10	0.8616672	0.8407286	0.8203483	0.8005101	0.7811984	0.7623979	0.7440939	10
11	0.8489332	0.8262689	0.8042630	0.7828950	0.7621448	0.7419931	0.7224213	11
12	0.8363874	0.8120579	0.7884932	0.7656675	0.7435559	0.7221344	0.7013799	12
13	0.8240270	0.7980913	0.7730325	0.7488191	0.7254204	0.7028972	0.6809513	13
14	0.8118493	0.7843649	0.7578750	0.7323414	0.7077272	0.6839973	0.6611178	14
15	0.7998515	0.7708746	0.7430147	0.7162263	0.6904656	0.6656908	0.6418620	15
16	0.7880310	0.7576163	0.7284458	0.7004658	0.6736249	0.6478742	0.6231669	16
17	0.7763853	0.7445861	0.7141626	0.6850521	0.6571951	0.6305345	0.6050165	17
18	0.7649116	0.7317799	0.7001594	0.6699776	0.6411659	0.6136589	0.5873946	18
19	0.7536075	0.7191940	0.6864308	0.6532348	0.6255277	0.5972350	0.5702800	19
20	0.7424704	0.7068246	0.6729713	0.6408165	0.6102709	0.5812506	0.5536758	20
21	0.7314980	0.6946679	0.6597758	0.6267154	0.5953863	0.5656940	0.5375493	21
22	0.7206876	0.6827203	0.6468390	0.6129246	0.5808647	0.5505538	0.5218925	22
23	0.7100371	0.6709782	0.6341559	0.5994372	0.5666972	0.5358187	0.5066918	23
24	0.6995439	0.6594380	0.6217215	0.5862467	0.5528754	0.5214781	0.4919337	24
25	0.6892058	0.6480963	0.6095309	0.5733464	0.5393906	0.5075213	0.4776056	25
26	0.6790205	0.6369497	0.5975793	0.5607300	0.5262347	0.4939380	0.4636947	26
27	0.6689857	0.6259948	0.5858620	0.5483912	0.5133997	0.4807182	0.4501891	27
28	0.6590993	0.6152283	0.5743746	0.5363239	0.5008778	0.4678523	0.4370768	28
29	0.6493589	0.6046476	0.5631123	0.5245221	0.4886613	0.4553307	0.4243464	29
30	0.6397624	0.5942476	0.5520709	0.5129804	0.4767427	0.4431442	0.4119868	30
31	0.6303078	0.5840272	0.5412460	0.5016920	0.4651148	0.4312839	0.3999872	31
32	0.6209929	0.5739825	0.5306333	0.4906523	0.4537706	0.4197410	0.3883370	32
33	0.6118157	0.5641105	0.5202287	0.4798556	0.4427030	0.4085071	0.3770263	33
34	0.6027741	0.5544084	0.5100282	0.4692964	0.4319053	0.3975738	0.3660449	34
35	0.5938861	0.5448731	0.5000276	0.4589696	0.4213711	0.3869331	0.3553834	35
36	0.5850897	0.5355018	0.4902232	0.4488700	0.4110937	0.3765773	0.3450324	36
37	0.5764431	0.5262917	0.4806109	0.4389927	0.4010671	0.3664986	0.3349829	37
38	0.5679242	0.5172400	0.4711872	0.4293327	0.3912849	0.3566896	0.3252262	38
39	0.5595313	0.5083440	0.4619482	0.4198853	0.3817414	0.3471432	0.3157536	39
40	0.5512623	0.4996010	0.4528904	0.4106458	0.3724306	0.3378522	0.3065568	40
41	0.5431156	0.4910083	0.4440102	0.4016095	0.3633470	0.3288100	0.2976280	41
42	0.5350893	0.4825635	0.4353041	0.3927722	0.3544848	0.3200097	0.2889592	42
43	0.5271815	0.4742639	0.4267688	0.3841293	0.3458389	0.3114450	0.2805429	43
44	0.5193907	0.4661070	0.4184007	0.3756765	0.3374038	0.3031094	0.2723718	44
45	0.5117149	0.4580904	0.4101968	0.3674098	0.3291744	0.2949970	0.2644386	45
46	0.5041527	0.4502117	0.4021537	0.3593250	0.3211458	0.2871017	0.2567365	46
47	0.4967021	0.4424685	0.3942684	0.3514181	0.3133129	0.2794177	0.2492588	47
48	0.4893617	0.4348585	0.3865376	0.3436852	0.3056712	0.2719394	0.2419988	48
49	0.4821298	0.4273793	0.3789584	0.3361224	0.2982158	0.2646612	0.2349503	49
50	0.4750047	0.4202088	0.3715279	0.3287261	0.2909422	0.2575778	0.2281071	50
51	0.4679849	0.4128048	0.3642430	0.3214925	0.2838461	0.2506840	0.2214632	51
52	0.4610689	0.4057049	0.3571010	0.3144181	0.2769230	0.2439747	0.2150128	52
53	0.4542551	0.3987272	0.3500990	0.3074994	0.2701688	0.2374450	0.2087503	53
54	0.4475419	0.3918695	0.3432343	0.3007329	0.2635793	0.2310900	0.2026702	54
55	0.4409280	0.3851297	0.3365043	0.2941153	0.2571505	0.2249051	0.1967762	55
56	0.4344118	0.3785059	0.3299060	0.2876433	0.2508786	0.2188858	0.1910361	56
57	0.4279919	0.3719959	0.3234374	0.2813137	0.2447596	0.2130275	0.1854719	57
58	0.4216669	0.3655930	0.3170955	0.2751235	0.2387898	0.2073200	0.1800698	58
59	0.4154354	0.3593100	0.3108779	0.2690694	0.2329657	0.2017772	0.1748251	59
60	0.4092960	0.3531303	0.3047823	0.2631486	0.2272836	0.1963768	0.1697331	60

TABLE 34.—*The present value of 1 due in n years—Continued.*

$$v^n = (1+i)^{-n}.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	0.9661836	0.9615385	0.9569378	0.9523810	0.9478673	0.9433962	0.9345794	1
2	0.9335107	0.9245562	0.9157300	0.9070295	0.8984524	0.8899964	0.8734387	2
3	0.9019427	0.8889964	0.8762966	0.8638376	0.8516137	0.8396193	0.8162979	3
4	0.8714422	0.8548042	0.8385613	0.8227025	0.8072167	0.7920937	0.7628952	4
5	0.8419732	0.8219271	0.8024511	0.7835262	0.7651344	0.7472582	0.7129862	5
6	0.8135006	0.7903145	0.7678957	0.7462154	0.7252458	0.7049605	0.6663422	6
7	0.7859910	0.7599178	0.7348285	0.7106813	0.6874368	0.6650571	0.6227497	7
8	0.7594116	0.7306902	0.7031851	0.6768394	0.6515989	0.6274124	0.5820091	8
9	0.7337310	0.7025867	0.6729044	0.6446089	0.6176293	0.5918985	0.5493337	9
10	0.7089188	0.6755642	0.6439277	0.6139133	0.5854306	0.5583948	0.5083493	10
11	0.6849457	0.6495809	0.6161987	0.5846793	0.5549105	0.5267875	0.4750928	11
12	0.6617833	0.6245971	0.5896639	0.5568374	0.5259815	0.4969694	0.440120	12
13	0.6394042	0.6005741	0.5642716	0.5303214	0.4985607	0.4688390	0.4149645	13
14	0.6177818	0.5774751	0.5399729	0.5050680	0.4725694	0.4423010	0.3878172	14
15	0.5968906	0.5552645	0.5167204	0.4810171	0.4479331	0.4172651	0.3624460	15
16	0.5767059	0.5339082	0.4944693	0.4581115	0.4245811	0.3936463	0.3387346	16
17	0.5572038	0.5133733	0.4731764	0.4362967	0.4024465	0.3713644	0.3165744	17
18	0.5383611	0.4936281	0.4528004	0.4155207	0.3814659	0.3503438	0.2958639	18
19	0.5201557	0.4746424	0.4330318	0.3957340	0.3615791	0.3305130	0.2765083	19
20	0.5026569	0.4563870	0.4146429	0.3768895	0.3427290	0.3118047	0.2584190	20
21	0.4855709	0.4388336	0.3967874	0.3589424	0.3248616	0.2941554	0.2415131	21
22	0.4691506	0.4219554	0.3797009	0.3418499	0.3079257	0.2775051	0.2257132	22
23	0.4532856	0.4057263	0.3633501	0.3255713	0.2918727	0.2617973	0.2109469	23
24	0.4379571	0.3901215	0.3477035	0.3100679	0.2766566	0.2469786	0.1971466	24
25	0.4231470	0.3751168	0.3327306	0.2953028	0.2622237	0.2329986	0.1842192	25
26	0.4088377	0.3606892	0.3184025	0.2812407	0.2485628	0.2198100	0.1721955	26
27	0.3950122	0.3468166	0.304914	0.2678483	0.2356045	0.2073680	0.1609304	27
28	0.3816543	0.3334775	0.2915707	0.2550936	0.2233218	0.1951301	0.1504022	28
29	0.3687482	0.3205614	0.2790150	0.2429463	0.2116794	0.1845567	0.1405628	29
30	0.3562784	0.3083187	0.2670000	0.2313775	0.2006440	0.1741101	0.1313671	30
31	0.3442304	0.2964603	0.2555024	0.2203595	0.1901839	0.1642548	0.1227730	31
32	0.3325897	0.2850579	0.2444999	0.2098662	0.1802691	0.1549574	0.1147411	32
33	0.3213427	0.2740942	0.2339712	0.1998725	0.1708712	0.1461862	0.1072347	33
34	0.3104761	0.2635521	0.2238959	0.1903548	0.1619632	0.1379115	0.1002193	34
35	0.2999769	0.2534155	0.2142544	0.1812903	0.1535196	0.1301052	0.0996629	35
36	0.2898327	0.2436687	0.2050282	0.1726574	0.1455162	0.1227408	0.0875355	36
37	0.2800316	0.2342969	0.1961992	0.1644356	0.1379301	0.1157932	0.0818088	37
38	0.2705619	0.2252854	0.1877504	0.1566034	0.1307394	0.1092389	0.0764569	38
39	0.2614125	0.2166206	0.1796655	0.1491480	0.1239236	0.1030555	0.0714550	39
40	0.2525725	0.2082890	0.1719287	0.1420457	0.1174631	0.0972222	0.0667804	40
41	0.2440314	0.2002779	0.1645251	0.1352816	0.1113395	0.0917191	0.0624116	41
42	0.2357791	0.1925749	0.1574403	0.1288396	0.1055350	0.0865274	0.0583286	42
43	0.2278059	0.1851682	0.1506605	0.1227044	0.1000332	0.0816296	0.0545127	43
44	0.2201023	0.1780464	0.1441728	0.1168613	0.0948182	0.0770091	0.0509464	44
45	0.2126592	0.1711984	0.1379644	0.1112965	0.0898751	0.0726501	0.0476135	45
46	0.2054679	0.1646139	0.1320233	0.1059967	0.0851897	0.0685378	0.0444986	46
47	0.1985197	0.1582826	0.1263381	0.1009492	0.0807485	0.0646583	0.0415875	47
48	0.1918065	0.1521948	0.1208977	0.0961421	0.0765389	0.0609984	0.0388668	48
49	0.1853202	0.1463411	0.1156916	0.0915639	0.0725487	0.0575457	0.0363241	49
50	0.1790554	0.1407126	0.1107097	0.0872037	0.0687665	0.0542884	0.0339478	50
51	0.1729984	0.1353006	0.1059423	0.0830512	0.0651815	0.0512154	0.0317269	51
52	0.1671482	0.1300967	0.1013801	0.0790964	0.0617834	0.0483165	0.0296513	52
53	0.1614959	0.1250930	0.0970145	0.0753299	0.0585625	0.0455816	0.0277115	53
54	0.1560347	0.1202817	0.0928368	0.0717427	0.0555095	0.0430015	0.0258986	54
55	0.1507581	0.1156555	0.0888391	0.0683264	0.0526156	0.0405674	0.0242043	55
56	0.1456600	0.1112072	0.0850135	0.0650728	0.0498726	0.0382712	0.0226208	56
57	0.1407343	0.1069300	0.0813526	0.0619741	0.0472726	0.0361049	0.0211410	57
58	0.1359752	0.1028173	0.0778494	0.0590229	0.0448082	0.0340612	0.0197579	58
59	0.1313770	0.0988628	0.0742970	0.0562123	0.0424722	0.0321332	0.0184653	59
60	0.1269343	0.0950604	0.0712890	0.0535355	0.0402580	0.0303143	0.0172573	60

TABLE 35.—*The present value of an annuity of 1 for n years.*

$$a_n = \frac{1-v^n}{i}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	0.9852217	0.9828010	0.9803922	0.9779951	0.9756098	0.9732360	0.9708738	1
2	1.9558834	1.9486988	1.9415009	1.9344696	1.9274242	1.9204243	1.9134697	2
3	2.9122004	2.8979840	2.8838833	2.8698969	2.8560236	2.8422621	2.8286114	3
4	3.8543847	3.8309425	3.8072287	3.7847402	3.7619742	3.7394279	3.7169984	4
5	4.7826450	4.7478551	4.7134595	4.6794525	4.6458285	4.6125819	4.5797072	5
6	5.6971872	5.6489976	5.6014309	5.5544768	5.5081254	5.4623668	5.4171914	6
7	6.5982140	6.5364144	6.4719911	6.4102463	6.3493906	6.2894081	6.2302830	7
8	7.4859251	7.4050530	7.3254814	7.2471846	7.1701372	7.0943144	7.0196922	8
9	8.3605173	8.2609425	8.1622367	8.0657062	7.9708655	7.8776783	7.7861089	9
10	9.2221846	9.1012229	8.9825850	8.8662164	8.7520639	8.6400762	8.5302028	10
11	10.0711178	9.9274918	9.7868481	9.6491113	9.5142087	9.3820693	9.2526241	11
12	10.9075052	10.753497	10.5753412	10.4147788	10.2577646	10.1042037	9.9540040	12
13	11.7315322	11.5376410	11.3483738	11.1635979	10.9831850	10.8071009	10.6349553	13
14	12.5433815	12.3220059	12.1062488	11.8959392	11.6909122	11.4910081	11.2960731	14
15	13.3432330	13.0928805	12.8492635	12.6121055	12.3813777	12.1566989	11.9379351	15
16	14.1312641	13.8504968	13.5777093	13.3126313	13.0550027	12.8045732	12.5611020	16
17	14.9076493	14.5950828	14.2918719	13.9976834	13.7121977	13.4351077	13.161185	17
18	15.6725609	15.3268627	14.9920313	14.6676611	14.3533636	14.0487666	13.7535131	18
19	16.4261684	16.0460567	15.674620	15.3228959	14.9788931	14.6460016	14.3237991	19
20	17.1686388	16.7528813	16.3514333	15.9637124	15.5891623	15.2272521	14.8774749	20
21	17.9001367	17.4475492	17.0112092	16.5904278	16.1845486	15.7929461	15.4150241	21
22	18.6208244	18.1305497	17.6504882	17.2033523	16.7654132	16.3434999	15.9369166	22
23	19.3308615	18.8012476	18.2922041	17.8027896	17.3321105	16.8793186	16.4436084	23
24	20.0304054	19.4606857	18.9139256	18.3890362	17.8849858	17.4007967	16.9355421	24
25	20.7196112	20.1087820	19.5234565	18.9623826	18.4243764	17.9083180	17.4131477	25
26	21.3986317	20.7457317	20.1210358	19.5231126	18.9506111	18.4022559	17.8768424	26
27	22.0676175	21.3717264	20.7068978	20.1715038	19.4640109	18.8434999	18.3270315	27
28	22.7267167	21.9869547	21.2812724	20.6078276	19.9648887	19.3508264	18.7641082	28
29	23.3767056	22.5916017	21.8443847	21.1323498	20.4535499	19.8061571	19.1884546	29
30	24.0158380	23.1858493	22.3964556	21.6453299	20.9302926	20.2493013	19.6004414	30
31	24.6461458	23.7698765	22.9377015	22.1470219	21.3954074	20.6805852	20.0004285	31
32	25.2671387	24.3438590	23.4683348	22.6376742	21.8491780	21.1003262	20.3887655	32
33	25.8785944	24.9079695	23.9885636	23.1175298	22.2918809	21.5088333	20.7657918	33
34	26.4817285	25.4623779	24.4985917	23.5868262	22.7237863	21.9064071	21.1318367	34
35	27.0759546	26.0072510	24.9986193	24.0457958	23.1451573	22.2933403	21.4872201	35
36	27.6606843	26.5427528	25.4888425	24.4946658	23.5562511	22.6699175	21.8322525	36
37	28.2371274	27.0690446	25.9694534	24.9336585	23.9573181	23.0364161	22.1672334	37
38	28.8050516	27.5862846	26.4406406	25.3629912	24.3486030	23.3931057	22.4924616	38
39	29.3645829	28.0946286	26.9025888	25.7828765	24.7303444	23.7402488	22.8082151	39
40	29.9158452	28.5942296	27.3554792	26.1935222	25.1027751	24.0781011	23.1147720	40
41	30.4589608	29.0852379	27.7994895	26.5951317	25.4661220	24.4069110	23.4124000	41
42	30.9940500	29.5678014	28.2347936	26.9879039	25.8206068	24.7269207	23.7013592	42
43	31.5212316	30.0420652	28.6615623	27.3720332	26.1664457	25.0383656	23.9819021	43
44	32.0406222	30.5081722	29.079631	27.7477097	26.5038495	25.3414751	24.2542739	44
45	32.5523372	30.9662626	29.4901599	28.1151195	26.8330239	25.6364721	24.5187125	45
46	33.0564898	31.4164743	29.8923136	28.4744445	27.1541696	25.9235738	24.7754491	46
47	33.5531920	31.8589428	30.2865820	28.8258626	27.4674826	26.2029915	25.0247078	47
48	34.0425537	32.2938013	30.6731196	29.1695478	27.7731537	26.4749309	25.2667066	48
49	34.5246334	32.7211806	31.0520780	29.5056702	28.0713695	26.7395922	25.5016569	49
50	34.9996881	33.1412095	31.4236059	29.8343963	28.3623117	26.9971700	25.7297640	50
51	35.4676730	33.5540142	31.7878489	30.1558888	28.6461577	27.2478540	25.9512272	51
52	35.9287419	33.9597191	32.144949	30.4703069	28.9230807	27.4918287	26.1662400	52
53	36.3829969	34.3584463	32.4950489	30.7778062	29.1932495	27.7292737	26.3749903	53
54	36.8305388	34.7503158	32.8382833	31.0785391	29.4568288	27.9603637	26.5776605	54
55	37.2714668	35.1354455	33.1747875	31.3726544	29.7139798	28.1852688	26.7744276	55
56	37.7058786	35.5139514	33.5046937	31.6602977	29.9648578	28.4041545	26.9654637	56
57	38.1338706	35.8859473	33.8281310	31.9416114	30.2096174	28.6171820	27.1509357	57
58	38.5555375	36.2515452	34.1452265	32.2167349	30.4484072	28.825081	27.3310055	58
59	38.9709729	36.6105553	34.4561044	32.4858043	30.6813729	29.0262852	27.5058306	59
60	39.3802689	36.9639855	34.7608867	32.7489592	30.9086565	29.226620	27.6755637	60

TABLE 35.—*The present value of an annuity of 1 for n years—Continued.*

$$a_n = \frac{1-v^n}{i}$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	0.9661836	0.9615385	0.9569378	0.9523810	0.9478673	0.9433962	0.9345794	1
2	1.8996943	1.8860947	1.8726678	1.8594104	1.8463197	1.8333927	1.8080182	2
3	2.8016370	2.7750910	2.7489644	2.7232480	2.6979334	2.6730120	2.6243160	3
4	3.6730792	3.6298952	3.5875257	3.5459505	3.5051501	3.4651056	3.3872113	4
5	4.5150524	4.4518223	4.3899767	4.3294767	4.2702845	4.2123638	4.1001974	5
6	5.3285530	5.2421369	5.1578725	5.07569 3	4.9955303	4.9173243	4.7665397	6
7	6.1145440	6.0020547	5.8927009	5.7863731	5.6829671	5.5823814	5.3892894	7
8	6.8739555	6.7327449	6.5958861	6.4632128	6.3345660	6.2097938	5.9712985	8
9	7.6078665	7.4353316	7.2687905	7.1078217	6.9521953	6.8016923	6.5152323	9
10	8.3166053	8.1108958	7.9127182	7.7217349	7.5376258	7.3600871	7.0235816	10
11	9.0015510	8.7604767	8.5289169	8.3064142	8.0925363	7.8868746	7.4986744	11
12	9.6633343	9.3850738	9.1185808	8.8632516	8.6185179	8.3838439	7.9426863	12
13	10.3027385	9.9856479	9.6828524	9.3935730	9.1170785	8.8266830	8.3576508	13
14	10.9205203	10.5631229	10.2228253	9.8986409	9.5896479	9.2949839	8.7454680	14
15	11.5174109	11.1183874	10.7395457	10.3796580	10.0375809	9.7122490	9.1079140	15
16	12.0941168	11.6522956	11.2340151	10.8377696	10.4621620	10.1058953	9.4466486	16
17	12.6513206	12.1656689	11.7071914	11.2740663	10.8646086	10.4772597	9.7632230	17
18	13.1896167	12.6592970	12.1599918	11.6895869	11.2460745	10.8276035	10.0509669	18
19	13.7098374	13.1339394	12.5932936	12.0853209	11.6076535	11.1581165	10.3353953	19
20	14.2124033	13.5903263	13.0079365	12.4622103	11.9503825	11.4699212	10.5940143	20
21	14.6979742	14.0291600	13.4047239	12.8211527	12.2752441	11.7640766	10.8355273	21
22	15.1671248	14.4511153	13.7844248	13.1630026	12.5831697	12.0415817	11.0612405	22
23	15.6204105	14.8568417	14.1477749	13.4885739	12.8750424	12.3033790	11.2721874	23
24	16.0583676	15.2409631	14.4954784	13.7986418	13.1516990	12.5503375	11.4693340	24
25	16.4815146	15.6220799	14.8282090	14.0939446	13.4139327	12.7833562	11.6535832	25
26	16.8903523	15.9827692	15.1466115	14.3751853	13.6624954	13.0031662	11.8257787	26
27	17.2853645	16.3295858	15.4513028	14.6430336	13.8909999	13.2105341	11.9867091	27
28	17.6670189	16.6630632	15.7428735	14.8981273	14.1214217	13.4061643	12.1371113	28
29	18.0357670	16.9837146	16.0218885	15.1410736	14.3331012	13.5907210	12.2776741	29
30	18.3920454	17.2920333	16.2888885	15.3724510	14.5337452	13.7648312	12.4090412	30
31	18.7362758	17.5884936	16.5443910	15.5928105	14.7239291	13.9290860	12.5318142	31
32	19.0688655	17.8735515	16.7888909	15.8026767	14.9041982	14.0840434	12.6465553	32
33	19.3902082	18.1476457	17.0228621	16.0025492	15.0750694	14.2302296	12.7537900	33
34	19.7006842	18.4111978	17.2467580	16.1929046	15.2370326	14.3681411	12.8540094	34
35	20.0006611	18.6646132	17.4610124	16.3741943	15.3905322	14.4982464	12.9476723	35
36	20.2904938	18.9082820	17.6660406	16.5468517	15.5360684	14.6209871	13.0352078	36
37	20.5705254	19.1425788	17.8622398	16.7112873	15.6739985	14.7367803	13.1170166	37
38	20.8410874	19.3678642	18.0499992	16.8678927	15.8047379	14.8460172	13.1934735	38
39	21.1024999	19.5844848	18.2296557	17.0170407	15.9286615	14.9490747	13.2649825	39
40	21.3550723	19.7927739	18.4015844	17.1590864	16.0461247	15.0462969	13.3317089	40
41	21.5991037	19.9930518	18.5661095	17.2943680	16.1574642	15.1380159	13.3941204	41
42	21.8348828	20.1856267	18.7235498	17.4232076	16.2629992	15.2245433	13.4524490	42
43	22.0626887	20.3707949	18.8742103	17.5459120	16.3630324	15.3061729	13.5069617	43
44	22.2827910	20.5488413	19.0183831	17.6627733	16.4578506	15.3831820	13.5579081	44
45	22.4954503	20.7200397	19.1563474	17.7740698	16.5477257	15.4558321	13.6055216	45
46	22.7009181	20.8846536	19.2883707	17.8800665	16.6329154	15.5243699	13.6500202	46
47	22.8994378	21.0429361	19.4147088	17.9810157	16.7136639	15.5890282	13.6916077	47
48	23.0912443	21.1951309	19.5356065	18.0771578	16.7902027	15.6500266	13.7304744	48
49	23.2765645	21.3414720	19.6512981	18.1687217	16.8627514	15.7057223	13.7667986	49
50	23.4556179	21.4821846	19.7620078	18.2559255	16.9315179	15.7618606	13.8007463	50
51	23.6286163	21.6174852	19.8675900	18.3389766	16.9966994	15.8130761	13.8324732	51
52	23.7957645	21.7475819	19.9693302	18.4180730	17.0584829	15.8613925	13.8621245	52
53	23.9572604	21.8726749	20.0663447	18.4934028	17.1170454	15.9069741	13.8898359	53
54	24.1132951	21.9929567	20.1591815	18.5651456	17.1725549	15.9499755	13.9157345	54
55	24.2640532	22.1086122	20.2480206	18.6334720	17.2251705	15.9905430	13.9399388	55
56	24.4097133	22.2198194	20.3330340	18.6985447	17.2750431	16.0288141	13.9625596	56
57	24.5504476	22.3267494	20.4143866	18.7605188	17.3223158	16.0649190	13.9837006	57
58	24.6864228	22.4295668	20.4922360	18.8195417	17.3671239	16.0989802	14.0034585	58
59	24.8177998	22.5284296	20.5667330	18.8757540	17.4095961	16.1311134	14.0219238	59
60	24.9447341	22.6234900	20.6380220	18.9292895	17.4498542	16.1614277	14.0391812	60

TABLE 36.—*The annuity for n years which 1 will buy or the annuity needed to discharge a debt of 1 in n years with interest.*

$$\frac{1}{a_n} = \frac{i}{1-v^n}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0150000	1.0175000	1.0200000	1.0225000	1.0250000	1.0275000	1.0300000	1
2	0.5112779	0.5131630	0.5150495	0.5169376	0.5188272	0.5207183	0.5226108	2
3	0.3433830	0.3450675	0.3467547	0.3484446	0.3501372	0.3518324	0.3535304	3
4	0.2594448	0.2610324	0.2626238	0.2642189	0.2658179	0.2674206	0.2690271	4
5	0.2090893	0.2106214	0.2121584	0.2137002	0.2152469	0.2167983	0.2183546	5
6	0.1755252	0.1770226	0.1785258	0.1800350	0.1815500	0.1830708	0.1845975	6
7	0.1515562	0.1530306	0.1545120	0.1560003	0.1574954	0.1589975	0.1605064	7
8	0.1335840	0.1350429	0.1365098	0.1379846	0.1394674	0.1409580	0.1424564	8
9	0.1196098	0.1210581	0.1225154	0.1239817	0.1254569	0.1269410	0.1284339	9
10	0.1084342	0.1098754	0.1113265	0.1127877	0.1142588	0.1157397	0.1172305	10
11	0.0992938	0.1007304	0.1021779	0.1036365	0.1051060	0.1065863	0.1080775	11
12	0.0916800	0.0931138	0.0945596	0.0960174	0.0974871	0.0989687	0.1004621	12
13	0.0852404	0.0866728	0.0881184	0.0895769	0.0910483	0.0925325	0.0940295	13
14	0.0797233	0.0811556	0.0826020	0.0840623	0.0855365	0.0870246	0.0885263	14
15	0.0749444	0.0763774	0.0778255	0.0792885	0.0807665	0.0822592	0.0837666	15
16	0.0707651	0.0721996	0.0736501	0.0751166	0.0765990	0.0780971	0.0796109	16
17	0.0670797	0.0685162	0.0699698	0.0714404	0.0729278	0.0744319	0.0759525	17
18	0.0638058	0.0652449	0.0667021	0.0681772	0.0696701	0.0711806	0.0727087	18
19	0.0608785	0.0623206	0.0637818	0.0652618	0.0667606	0.0682780	0.0698139	19
20	0.0582457	0.0596912	0.0611567	0.0626421	0.0641471	0.0656717	0.0672157	20
21	0.0558655	0.0573146	0.0587848	0.0602757	0.0617873	0.0633194	0.0648718	21
22	0.0537033	0.0551564	0.0566314	0.0581282	0.0596466	0.0611864	0.0627474	22
23	0.0517308	0.0531880	0.0546681	0.0561710	0.0576961	0.0592441	0.0608139	23
24	0.0499241	0.0513857	0.0528711	0.0543803	0.0559128	0.0574686	0.0590474	24
25	0.0482635	0.0497295	0.0512204	0.0527360	0.0542759	0.0558400	0.0574279	25
26	0.0467320	0.0482027	0.0496992	0.0512213	0.0527688	0.0543412	0.0559383	26
27	0.0453153	0.0467908	0.0482931	0.0498219	0.0513769	0.0529578	0.0545642	27
28	0.0440011	0.0454815	0.0469897	0.0485253	0.0500879	0.0516774	0.0532932	28
29	0.0427788	0.0442642	0.0457784	0.0473208	0.0488913	0.0504894	0.0521147	29
30	0.0416392	0.0431298	0.0446499	0.0461993	0.0477776	0.0493844	0.0510193	30
31	0.0405743	0.0420701	0.0435963	0.0451528	0.0467390	0.0483545	0.0499989	31
32	0.0395771	0.0410781	0.0426106	0.0441742	0.0457683	0.0473926	0.0490466	32
33	0.0386414	0.0401478	0.0416865	0.0432572	0.0448594	0.0464925	0.0481561	33
34	0.0377619	0.0392736	0.0408187	0.0423966	0.0440068	0.0456488	0.0473220	34
35	0.0369336	0.0384508	0.0400022	0.0415873	0.0432056	0.0448565	0.0465393	35
36	0.0361524	0.0376751	0.0392329	0.0408252	0.0424516	0.0441113	0.0458038	36
37	0.0354144	0.0369426	0.0385068	0.0401064	0.0417409	0.0434095	0.0451116	37
38	0.0347161	0.0362499	0.0378206	0.0394275	0.0410701	0.0427476	0.0444593	38
39	0.0340546	0.0355940	0.0371711	0.0387854	0.0404362	0.0421226	0.0438439	39
40	0.0334271	0.0349721	0.0365558	0.0381774	0.0398362	0.0415315	0.0432624	40
41	0.0328311	0.0343817	0.0359719	0.0376009	0.0392679	0.0409720	0.0427124	41
42	0.0322643	0.0338206	0.0354173	0.0370536	0.0387288	0.0404418	0.0421917	42
43	0.0317247	0.0332867	0.0348899	0.0365336	0.0382169	0.0399387	0.0416981	43
44	0.0312104	0.0327781	0.0343879	0.0360390	0.0377304	0.0394610	0.0412299	44
45	0.0307198	0.0322932	0.0339096	0.0355681	0.0372675	0.0390069	0.0407852	45
46	0.0302512	0.0318304	0.0334534	0.0351192	0.0368268	0.0385749	0.0403625	46
47	0.0298034	0.0313884	0.0330179	0.0346911	0.0364067	0.0381636	0.0399605	47
48	0.0293750	0.0309657	0.0326018	0.0342823	0.0360060	0.0377716	0.0395778	48
49	0.0289648	0.0305612	0.0322040	0.0338918	0.0356235	0.0373977	0.0392131	49
50	0.0285717	0.0301739	0.0318232	0.0335184	0.0352581	0.0370409	0.0388655	50
51	0.0281947	0.0298027	0.0314586	0.0331610	0.0349087	0.0367001	0.0385338	51
52	0.0278329	0.0294466	0.0311091	0.0328188	0.0345745	0.0363744	0.0382172	52
53	0.0274854	0.0291049	0.0307739	0.0324909	0.0342545	0.0360630	0.0379147	53
54	0.0271514	0.0287767	0.0304523	0.0321765	0.0339480	0.0357649	0.0376256	54
55	0.0268302	0.0284613	0.0301434	0.0318749	0.0336542	0.0354795	0.0373491	55
56	0.0265211	0.0281580	0.0298466	0.0315853	0.0333724	0.0352061	0.0370845	56
57	0.0262234	0.0278661	0.0295612	0.0313071	0.0331020	0.0349440	0.0368311	57
58	0.0259366	0.0275850	0.0292867	0.0310398	0.0328424	0.0346927	0.0365885	58
59	0.0256601	0.0273143	0.0290224	0.0307827	0.0325931	0.0344515	0.0363559	59
60	0.0253934	0.0270534	0.0287680	0.0305353	0.0323534	0.0342200	0.0361330	60

TABLE 36.—*The annuity for n years which 1 will buy or the annuity needed to discharge a debt of 1 in n years with interest—Continued.*

$$\frac{1}{a_n} = \frac{i}{1 - v^n}$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	1.0350000	1.0400000	1.0450000	1.0500000	1.0550000	1.0600000	1.0700000	1
2	0.5264005	0.5301961	0.5339976	0.5378049	0.5416180	0.5454369	0.5530918	2
3	0.3569342	0.3603485	0.3637734	0.3672086	0.3706541	0.3741098	0.3810517	3
4	0.2722511	0.2754901	0.2787437	0.2820118	0.2852945	0.2885915	0.2952281	4
5	0.2214814	0.2246271	0.2277916	0.2309748	0.2341764	0.2373964	0.2438907	5
6	0.1876682	0.1907619	0.1938784	0.1970175	0.2001790	0.2033626	0.2097958	6
7	0.1635445	0.1666096	0.1697015	0.1728198	0.1759644	0.1791350	0.1855532	7
8	0.1454767	0.1485278	0.1516097	0.1547218	0.1578640	0.1610359	0.1674678	8
9	0.1314460	0.1344930	0.1375745	0.1406901	0.1438395	0.1470222	0.1534865	9
10	0.1202414	0.1232909	0.1263788	0.1295046	0.1326678	0.1358680	0.1423775	10
11	0.1110920	0.1141490	0.1172482	0.1203889	0.1235707	0.1267929	0.1333569	11
12	0.1034840	0.1065522	0.1096662	0.1128254	0.1160292	0.1192770	0.1259020	12
13	0.0970616	0.1001437	0.1032754	0.1064558	0.1096843	0.1129601	0.1196509	13
14	0.0915707	0.0946690	0.0978203	0.1010240	0.1042791	0.1075849	0.1143449	14
15	0.0868251	0.0899411	0.0931138	0.0963423	0.0996256	0.1029628	0.1097946	15
16	0.0826848	0.0858200	0.0890154	0.0922699	0.0955825	0.0989521	0.1058577	16
17	0.0790431	0.0821985	0.0854176	0.0886999	0.0920420	0.0954448	0.1024252	17
18	0.0758168	0.0789933	0.0822369	0.0855462	0.0889199	0.0923565	0.0994126	18
19	0.0729403	0.0761386	0.0794307	0.0827450	0.0861501	0.0896209	0.0967530	19
20	0.0703611	0.0735818	0.0768761	0.0802426	0.0836793	0.0871846	0.0943929	20
21	0.0680366	0.0712801	0.0746006	0.0779961	0.0814648	0.0850046	0.0922890	21
22	0.0659321	0.0691988	0.0725457	0.0759705	0.0794712	0.0830456	0.0904058	22
23	0.0640188	0.0673091	0.0706825	0.0741368	0.0776696	0.0812785	0.0887139	23
24	0.0622728	0.0655868	0.0689870	0.0724709	0.0760358	0.0796709	0.0871890	24
25	0.0606740	0.0640120	0.0674390	0.0709525	0.0745494	0.0782267	0.0858105	25
26	0.0592054	0.0625674	0.0660214	0.0695643	0.0731931	0.0769044	0.0845610	26
27	0.0578524	0.0612385	0.0647195	0.0682919	0.0719523	0.0756972	0.0834257	27
28	0.0566027	0.0600130	0.0635208	0.0671225	0.0708144	0.0745926	0.0823919	28
29	0.0554454	0.0588799	0.0624146	0.0660455	0.0697686	0.0735796	0.0814487	29
30	0.0543731	0.0578301	0.0613915	0.0650514	0.0688054	0.0726489	0.0805864	30
31	0.0533724	0.0568554	0.0604435	0.0641321	0.0679167	0.0717922	0.0797969	31
32	0.0524411	0.0559486	0.0595632	0.0632804	0.0670952	0.0710023	0.0790729	32
33	0.0515724	0.0551036	0.0587445	0.0624900	0.0663347	0.0702729	0.0784081	33
34	0.0507597	0.0543148	0.0579819	0.0617554	0.0656296	0.0695984	0.0777967	34
35	0.0499984	0.0535773	0.0572705	0.0610717	0.0649749	0.0689739	0.0772340	35
36	0.0492842	0.0528869	0.0566058	0.0604345	0.0643664	0.0683948	0.0767153	36
37	0.0486133	0.0522396	0.0559840	0.0598398	0.0637999	0.0678574	0.0762369	37
38	0.0479821	0.0516319	0.0554017	0.0592842	0.0632722	0.0673581	0.0757951	38
39	0.0473878	0.0510608	0.0548557	0.0587646	0.0627799	0.0668998	0.0753868	39
40	0.0468273	0.0505235	0.0543432	0.0582782	0.0623203	0.0664615	0.0750091	40
41	0.0462982	0.0500174	0.0538616	0.0578223	0.0618909	0.0660589	0.0746596	41
42	0.0457983	0.0495402	0.0534087	0.0573947	0.0614893	0.0656834	0.0743359	42
43	0.0453254	0.0490899	0.0529824	0.0569933	0.0611134	0.0653331	0.0740359	43
44	0.0448777	0.0486645	0.0525807	0.0566163	0.0607613	0.0650061	0.0737577	44
45	0.0444554	0.0482625	0.0522020	0.0562617	0.0604313	0.0647005	0.0734996	45
46	0.0440511	0.0478821	0.0518447	0.0559282	0.0601218	0.0644149	0.0732600	46
47	0.0436692	0.0475219	0.0515073	0.0556142	0.0598313	0.0641477	0.0730374	47
48	0.0433065	0.0471807	0.0511886	0.0553184	0.0595585	0.0638977	0.0728307	48
49	0.0429617	0.0468571	0.0508872	0.0550397	0.0593023	0.0636636	0.0726385	49
50	0.0426337	0.0465502	0.0506022	0.0547767	0.0590615	0.0634443	0.0724599	50
51	0.0423216	0.0462589	0.0503323	0.0545287	0.0588350	0.0632388	0.0722937	51
52	0.0420243	0.0459821	0.0500768	0.0542945	0.0586219	0.0630462	0.0721390	52
53	0.0417410	0.0457192	0.0498347	0.0540733	0.0584213	0.0628655	0.0719951	53
54	0.0414709	0.0454691	0.0496032	0.0538644	0.0582325	0.0626960	0.0718611	54
55	0.0412132	0.0452312	0.0493875	0.0536669	0.0580546	0.0625370	0.0717363	55
56	0.0409673	0.0450049	0.0491811	0.0534801	0.0578870	0.0623877	0.0716201	56
57	0.0407325	0.0447893	0.0489851	0.0533034	0.0577290	0.0622474	0.0715118	57
58	0.0405081	0.0445840	0.0487990	0.0531363	0.0575801	0.0621157	0.0714109	58
59	0.0402937	0.0443884	0.0486222	0.0529780	0.0574396	0.0619920	0.0713169	59
60	0.0400886	0.0442019	0.0484543	0.0528282	0.0573071	0.0618757	0.0712292	60

TABLE 37.—*Bid on a bond for \$100 to realize a given net income, interest payable semiannually.*

INTEREST 3½%.

Net income.	5 years.	10 years.	15 years.	20 years.	25 years.	30 years.
3.00	102.31	104.29	106.00	107.48	108.75	109.85
3.10	101.84	103.42	104.77	105.93	106.92	107.78
3.20	101.38	102.55	103.55	104.41	105.14	105.76
3.30	100.91	101.69	102.35	102.91	103.39	103.79
3.40	100.46	100.84	101.17	101.44	101.68	101.87
3.50	100.00	100.00	100.00	100.00	100.00	100.00
3.60	99.55	99.17	98.85	98.58	98.36	98.17
3.70	99.09	98.34	97.71	97.19	96.76	96.39
3.80	98.65	97.52	96.59	95.82	95.19	94.66
3.90	98.20	96.71	95.49	94.48	93.65	92.96
4.00	97.75	95.91	94.40	93.16	92.14	91.31
4.10	97.31	95.12	93.33	91.86	90.67	89.70
4.20	96.87	94.33	92.27	90.59	89.23	88.12
4.30	96.44	93.55	91.22	89.34	87.82	86.59
4.40	96.00	92.78	90.19	88.11	86.44	85.09
4.50	95.57	92.02	89.18	86.90	85.08	83.63
4.60	95.14	91.26	88.18	85.72	83.76	82.20
4.70	94.71	90.51	87.19	84.55	82.46	80.80
4.80	94.28	89.77	86.21	83.40	81.19	79.44
4.90	93.86	89.04	85.25	82.28	79.95	78.12
5.00	93.44	88.31	84.30	81.17	78.73	76.82

INTEREST 4%.

3.00	104.61	108.58	112.01	114.96	117.50	119.69
3.10	104.14	107.69	110.73	113.34	115.58	117.50
3.20	103.67	106.80	109.47	111.75	113.70	115.35
3.30	103.20	105.92	108.23	110.19	111.85	113.27
3.40	102.74	105.05	107.00	108.66	110.05	111.23
3.50	102.28	104.19	105.80	107.15	108.29	109.24
3.60	101.82	103.33	104.60	105.67	106.56	107.30
3.70	101.36	102.49	103.43	104.21	104.87	105.41
3.80	100.90	101.65	102.27	102.78	103.21	103.56
3.90	100.45	100.82	101.13	101.38	101.59	101.76
4.00	100.00	100.00	100.00	100.00	100.00	100.00
4.10	99.55	99.19	98.89	98.64	98.45	98.28
4.20	99.11	98.38	97.79	97.31	96.92	96.61
4.30	98.66	97.58	96.71	96.00	95.43	94.97
4.40	98.22	96.79	95.64	94.72	93.97	93.37
4.50	97.78	96.01	94.59	93.45	92.54	91.81
4.60	97.35	95.23	93.55	92.21	91.14	90.29
4.70	96.91	94.47	92.53	90.99	89.77	88.80
4.80	96.48	93.71	91.52	89.79	88.42	87.35
4.90	96.05	92.95	90.52	88.61	87.11	85.93
5.00	95.62	92.21	89.53	87.45	85.82	84.55

INTEREST 4½%.

3.00	106.92	112.88	118.01	122.44	126.25	129.54
3.10	106.44	111.96	116.69	120.75	124.23	127.22
3.20	105.96	111.05	115.39	119.09	122.26	124.95
3.30	105.49	110.15	114.11	117.47	120.32	122.74
3.40	105.02	109.26	112.84	115.87	118.43	120.59
3.50	104.55	108.38	111.59	114.30	116.57	118.48
3.60	104.08	107.50	110.36	112.75	114.75	116.43
3.70	103.62	106.64	109.15	111.24	112.98	114.42
3.80	103.16	105.78	107.95	109.74	111.23	112.47
3.90	102.70	104.93	106.77	108.28	109.53	110.56
4.00	102.25	104.09	105.60	106.84	107.86	108.69
4.10	101.79	103.25	104.45	105.42	106.22	106.87
4.20	101.34	102.43	103.31	104.03	104.62	105.09
4.30	100.89	101.61	102.19	102.66	103.05	103.35
4.40	100.44	100.80	101.09	101.32	101.51	101.66
4.50	100.00	100.00	100.00	100.00	100.00	100.00
4.60	99.56	99.21	98.93	98.70	98.52	98.38
4.70	99.12	98.42	97.86	97.43	97.08	96.80
4.80	98.68	97.64	96.82	96.17	95.66	95.26
4.90	98.25	96.87	95.79	94.94	94.27	93.75
5.00	97.81	96.10	94.77	93.72	92.91	92.27

TABLE 37.—*Bid on a bond for \$100 to realize a given net income, interest payable semiannually—Continued.*

INTEREST 5%.

Net income.	5 years.	10 years.	15 years.	20 years.	25 years.	30 years.
3.00	109.22	117.17	124.02	129.92	135.00	139.38
3.10	108.74	116.23	122.65	128.16	132.89	136.93
3.20	108.26	115.30	121.31	126.44	130.81	134.55
3.30	107.78	114.38	119.99	124.75	128.79	132.22
3.40	107.30	113.47	118.68	123.08	126.80	129.94
3.50	106.83	112.56	117.39	121.45	124.86	127.72
3.60	106.35	111.67	116.12	119.84	122.95	125.55
3.70	105.88	110.78	114.86	118.26	121.08	123.44
3.80	105.42	109.91	113.62	116.70	119.26	121.37
3.90	104.95	109.04	112.40	115.18	117.47	119.35
4.00	104.49	108.18	111.20	113.68	115.71	117.38
4.10	104.03	107.32	110.01	112.20	113.99	115.45
4.20	103.57	106.48	108.84	110.75	112.31	113.57
4.30	103.12	105.64	107.68	109.33	110.66	111.74
4.40	102.67	104.81	106.54	107.93	109.04	109.94
4.50	102.22	103.99	105.41	106.55	107.46	108.19
4.60	101.77	103.18	104.30	105.19	105.91	106.47
4.70	101.32	102.37	103.20	103.86	104.38	104.80
4.80	100.88	101.57	102.12	102.55	102.89	103.16
4.90	100.44	100.78	101.05	101.27	101.43	101.56
5.00	100.00	100.00	100.00	100.00	100.00	100.00

INTEREST 6%.

3.50	111.38	120.94	128.98	135.74	141.43	146.20
3.60	110.89	120.01	127.63	134.01	139.34	143.81
3.70	110.41	119.08	126.30	132.30	137.30	141.47
3.80	109.93	118.16	124.98	130.63	135.30	139.18
3.90	109.46	117.25	123.68	128.98	133.34	136.94
4.00	108.98	116.35	122.40	127.36	131.42	134.76
4.10	108.51	115.46	121.13	125.76	129.54	132.63
4.20	108.04	114.58	119.88	124.19	127.70	130.54
4.30	107.58	113.70	118.65	122.65	125.89	128.50
4.40	107.11	112.83	117.43	121.14	124.11	126.51
4.50	106.65	111.97	116.23	119.65	122.38	124.56
4.60	106.19	111.12	115.05	118.18	120.67	122.66
4.70	105.73	110.28	113.88	116.74	119.00	120.80
4.80	105.28	109.44	112.73	115.32	117.36	118.98
4.90	104.83	108.61	111.59	113.92	115.76	117.20
5.00	104.38	107.79	110.47	112.55	114.18	115.45
5.25	103.26	105.78	107.72	109.22	110.38	111.27
5.50	102.16	103.81	105.06	106.02	106.75	107.31
5.75	101.07	101.88	102.49	102.95	103.29	103.55
6.00	100.00	100.00	100.00	100.00	100.00	100.00

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